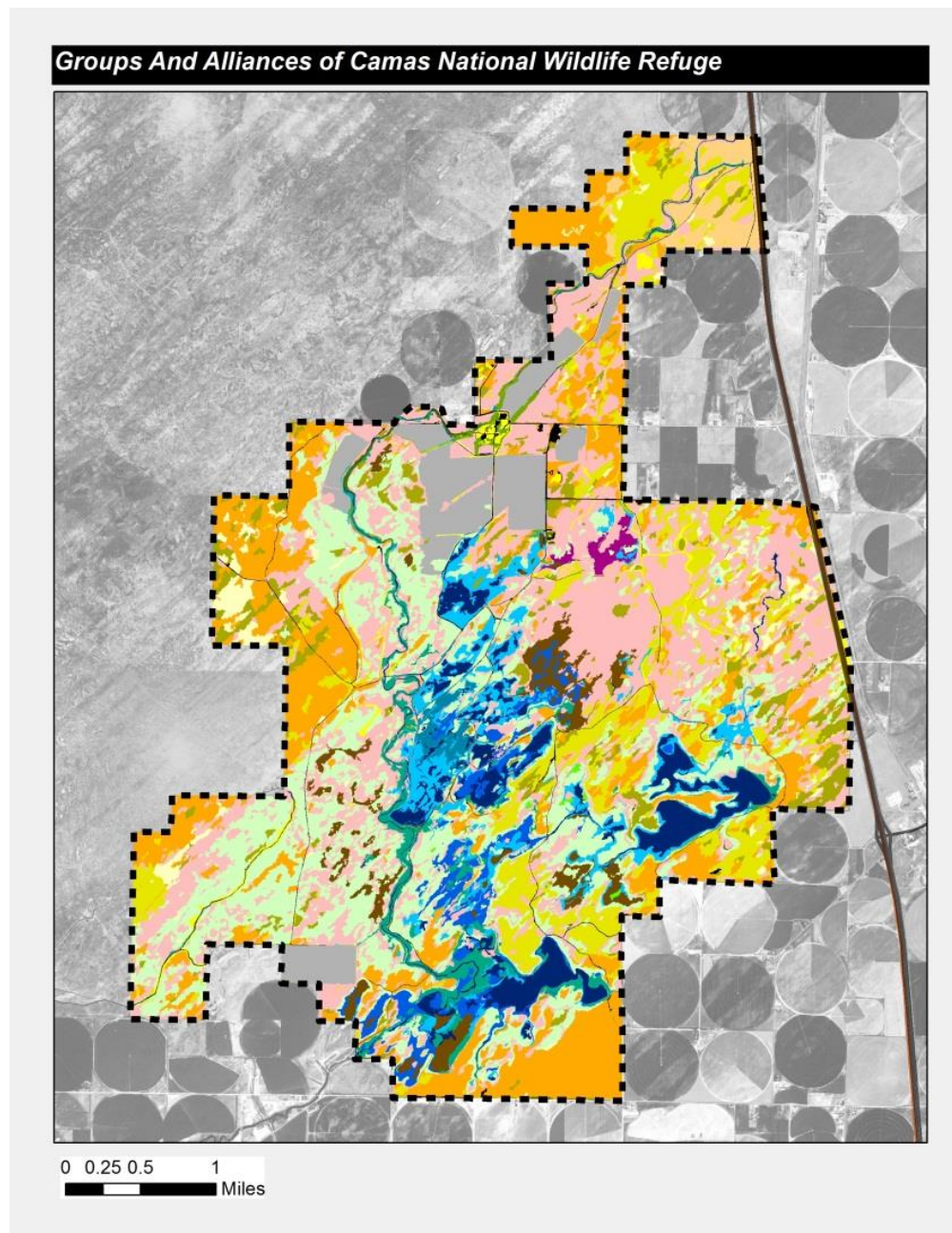

Camas National Wildlife Refuge

Vegetation Inventory, Classification, and Mapping

December, 2012



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Vegetation Database Development Methods

Introduction

This report accompanies the spatial vegetation/habitat database produced for Camas National Wildlife Refuge (NWR). The purpose of this report is to provide enough information so that the spatial vegetation database can be used with full knowledge of the quality of the data. The goal is to provide enough relevant information so that the methods could be followed with similar results.

This project occurred over the time period from Spring 2011 to Fall 2012. It was funded through the USFWS Inventory and Monitoring Initiative. The articulated goals of the project were to a) provide a vegetation mapping “pilot project” in Region 1 with a focus on articulating lessons learned, b) provide Camas NWR with a vegetation database that can be used for planning and refuge management, based upon methods with some rigor.

This report will first provide background for the project, including background on past habitat mapping projects, and an articulation of refuge needs that drove the project. Second, field methods and subsequent vegetation classification and legend development will be discussed. Next, remote sensing methodology is discussed, followed by the validation and accuracy assessment (AA) field campaign.

Finally, AA results will be evaluated, with an emphasis on understanding confusion between mapping classes. The appendices provide important information that accompany the use of the map. First, is a dichotomous key to the mapping classes of Camas NWR. Second, is an articulation of how ruderal classes are defined in the NVC. Third, are the National Vegetation Classification System (NVCS) full descriptions for NVCS Groups. Included in these descriptions are NVC-Habitat relationships developed by Refuge Biologists. The fourth appendix provides more detail on the NVCS Alliances, a finer grain of detail in the NVCS.

Background: Vegetation and Habitat Mapping at Camas NWR and Current Refuge Needs

Overview of Camas NWR

Camas National Wildlife Refuge was established October 12, 1937 near the community of Hamer, Idaho. The 10,578 acres which comprise the Refuge lie within Jefferson County, Idaho which is located in southeastern Idaho, 36 miles north of Idaho Falls at an elevation of about 4,800 feet. Camas Creek, which cuts through the heart of the refuge for about 8 miles, is the major supplier of water needed to hydrate wetlands and wet meadows. See Figure 1 for an overview of the area.

Camas Refuge is in the Basin and Range province, which occupies a small area of southern Idaho between the Middle Rocky Mountains and the Snake River Plain, west of the northern bound of the Central Rocky Mountains. The Beaver-Camas Watershed encompasses the Refuge and is the eastern-most of the local Central Valleys watersheds that collectively make up the Sinks Drainages (Idaho Department of Environmental Quality, 2005). The Sinks Drainages are a collection of closed surface drainage basins in southeast Idaho. The streams of these basins originate in the Pioneer, Lost River,

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Lemhi, and Centennial mountain ranges and flow generally east and south, eventually sinking into the fractured basalts of the Snake River Plain (Van Kirk et al, 2003).

The Beaver-Camas subbasin drains an area of 64,3083 acres (1005 square miles) within the Sinks Drainage and is bounded by the western edge of the Centennial Mountains and the eastern edge of the Beaverhead Mountains in the northern region of the subbasin. Beaver Creek and Camas Creek begin in the Centennial Mountains on the Idaho/Montana border and flow generally south and southwest, respectively. They converge just north of, and provide much of the water for, Camas National Wildlife Refuge. After exiting the refuge, the stream flows westward into Mud Lake; a natural playa “improved” with a dam forming a year-round impoundment (IDEQ, 2005). Groundwater flow for irrigation eventually reaches Mud Lake, which is the endpoint for all drainage in the subbasin. Camas Creek is 303(d) listed for flow alteration, sediment, and nutrients (IDEQ, 2005).

Brief Overview of Previous Vegetation Mapping and Inventory Efforts

A relatively detailed vegetation map for most of the refuge lands dates back to 1936 (Figure 2). This map was used to assess land values to support acquisition of the land. There is little known about how the map was developed, but it provides a fascinating look at vegetation patterns over 70 years ago. In 1988, a “Natural Potential” vegetation map was developed based upon providing vegetation types to SSURGO soil polygons. More recent inventories were completed by Dr. Matt Germino in 2009 (Figure 3). Germino’s work was not a vegetation mapping exercise *per se*. It was a range health inventory to assess the condition of different ecological sites, based upon Natural Resource Conservation Service (NRCS) ecological site descriptions. Germino’s 2009 work yielded several useful products for this project to drive the vegetation classification.

Refuge Needs

This 2011-2012 vegetation/habitat mapping project provides a focus on existing vegetation using the National Vegetation Classification Standard to determine mapping classes. It also includes an accuracy assessment. This project fills a gap in refuge knowledge by systematically sampling vegetation to NVCS map units to a relatively fine spatial detail.

Prior to mapping, Camas NWR staff provided information on why a vegetation mapping effort was needed and what their expected outcomes of the project were. The following provides information of refuge needs as provided by refuge staff. Also discussed here is how this final product meets or does not meet those stated refuge needs.

- **Record of vegetation change/Trend**

This database provides a record of vegetation from the period of 2009-2012. It can be used as a baseline spatial inventory at the time of Comprehensive Conservation Plan (CCP) implementation.

- **What type of vegetation/habitat is existing and proposed to manage Focal Species**

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This database provides new information to the manager regarding the type and quality of habitat across the refuge. For example, by incorporating “ruderal” types, the refuge manager has a spatially explicit accounting for where existing vegetation are not meeting current habitat objectives.

- **Existing and potential habitat mapping**

The database provides spatially explicit information on existing habitat, as well as information on potential habitat. The “potential” component is described using ecological systems, which captures the site potential of a certain patch.

- **Species composition by ecological site and canopy (height/composition)**

Height information is included in the database, as well as Matt Germino’s effort to map ecological site descriptions. The purpose of the database is to give the refuge manager enough flexibility to look at multiple dimensions of habitat to support species analyses. The database can be queried by a number of different spatial descriptors, such as pond unit, soil types, and by ecological site description.

- **Nesting/feeding/loafing sites for focal species**

This database has enough information related to vegetation type, height, and cover to develop species-habitat relationship models for a number of different focal species.

- **Upland vegetation native/nonnative/weeds**

This database provides information on native and non-native upland vegetation types. The database classifies spatial information on crested wheatgrass. It also classifies sagebrush steppe into native and understory ruderal types.

- **Emergent/submergent/floating vegetation**

Submergent vegetation is not included in the database. Emergent vegetation is mapped to three different Alliances: bulrush, cattail, and spike-rush.

- **What are the changes in vegetation due to changes in water (surface/subsurface)**

Spatial and temporal changes in open water are captured in the database over the years 2004, 2006, 2009, 2011. See figure 7. Water is a dominant driver of vegetation patterns across the wetland and wet meadow types. The data in this database can be used to develop relationships between hydrological flows and vegetation patterns. Subsurface water is not explicitly included in the database.

- **Simple map that can be used by any manager and biologist. But can still get the point across.**

The information can be displayed at a variety of levels of detail, from the “full” classification legend to a more simplified CCP habitat type map (See Figure 9).

Vegetation Sampling and Classification

Overview of the National Vegetation Classification Standard

One goal of this project is to develop a vegetation classification for Camas that meets the National Vegetation Classification System standard, as adopted by the Federal Geographic Data Committee (FGDC 2008). This classification has multiple scales to meet the needs identified by the refuge for the vegetation map, as well as developing protocols and articulating the deliverables required for a finalized vegetation mapping project. Utilizing the current NVC system at Camas NWR- will set a protocol by which the I & M program can compare data from Camas to other refuges using the same Federal standard.

Use of a standardized classification system helps to ensure data compatibility throughout the US Fish and Wildlife Service, as it has for the National Park Service and other agencies. The FGDC Vegetation Subcommittee works to keep this standard current and relevant. Classifying vegetation is a critical to sound ecological science and efficient land assessment, management and planning. The National Vegetation Classification (NVC) is a central organizing framework for how all vegetation in the United States is inventoried and studied, from broad scale formations (biomes) to fine-scale plant communities. The purpose of the NVC is to produce uniform statistics about vegetation resources across the nation, based on vegetation data gathered at local, regional, or national levels. The latest classification standard (version 2.0) was published in 2008 by the Federal Geographic Data Committee and provides the basis for ongoing refinement of the NVC.

Vegetation classification systems attempt to recognize and describe repeating assemblages of plants in similar habitats. The NVC is a hierarchical system that incorporates physiognomic characters and floristic data to define eight levels of terrestrial vegetation classification. The NVC is a hierarchical system that allows for vegetation classification at multiple scales (FGDC 2008). There are eight levels with specific criteria set for each level (Table 1). The upper three levels are based on climate and physiognomic characteristics that reflect geographically widespread (global) topographic and edaphic factors. The middle three levels focus largely on broad sets of diagnostic plant species and habitat factors along regional-to-continental topographic, edaphic, and disturbance gradients. These middle levels have been drafted and are undergoing peer review (Faber-Langendoen *et al.* 2010). The lower two levels, as in the original NVC, are the alliance and association and are distinguished by differences in local floristic composition (Grossman *et al.* 1998).

The mid-levels are often at an appropriate scale for vegetation mapping. At Camas, Groups and Alliances were the primary map classes. A Group is defined as the sixth level in the NVC natural vegetation hierarchy, in which each vegetation unit is defined by a group of plant communities with a common set of growth forms and diagnostic species or taxa (including several character species of the dominant growth forms), preferentially sharing a similar set of regional edaphic, topographic, and disturbance factors. (cf. Pignatti *et al.* 1995, Specht and Specht 2001). Groups are also very close in concept and scale to USFWS Habitat types used in refuge planning and goal setting.

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The alliance and association levels form the base of the NVC hierarchy and are determined by the most abundant or diagnostic species comprising the various layers of a homogenous vegetation community. An association is here defined as a plant community type with a consistent species composition, uniform physiognomy, and similar habitat conditions (Flahault and Schroter 1910). Species composition differentiates associations (TNC and ERSI 1994a). An alliance is "a physiognomically uniform group of plant associations sharing one or more dominant or diagnostic species which, as a rule, are found in the uppermost strata of the vegetation." (Reid and Comer 1998). NatureServe coordinates plant association data for various vegetation mapping projects. Associations are added to the NVC and older concepts are refined as new data become available.

Vegetation Inventory and Classification Methods & Results

Random points were generated across the refuge using a stratified design. We used a coarse ecosystem type map developed through a Germino's (2009) range health survey (Germino et al, 2009). This map assigned ecological site description (ESD) types to SSURGO polygons (Figure 2). Each ecological site description had 20-30 random points selected. However, the ESD map did not include riparian zones. A draft map of riparian zones was developed to generate random points in the riparian zone.

In summer 2011, two field crews spent a week in the field. Survey teams navigated to the randomly selected points. At each point we collected vegetation and soils metrics from a circular 0.1 ha area plot (1000 m², 0.25 acre), a circle with a radius of 18 m, centered on the GPS verified point. In addition we assessed the surrounding area by increasing the radius to 50 m, for a total area of 0.8 hectare (7854 m², 1.94 acres) encompassing the 0.1 ha plot. In this surrounding area we assessed the vegetation for homogeneity, in order to determine if the vegetation at the point is representative of the larger area (presumably the map polygon); this observation is an important field notation for mapping vegetation.

- Structure: Percent cover of each strata or layer present (tree, shrub, herbaceous) of vegetation and height
- Composition: Percent cover of each plant species identified within the assessment area.

A number of other site characteristics were assessed for the EIA, but independent of the vegetation classification and mapping, which is the focus of this report. Refer to the associated EIA and Climate Change Vulnerability Assessment for more detail. All vegetation data associated with the plots are located with the Camas EIA database.

Data collected at Camas in 2009 by Germino and in 2011 through this effort were classified to the finest unit possible within the National Vegetation Classification (NVC). 2011 field data were collected by the Idaho Fish and Game Restoration Program and NatureServe ecologists, with the assistance of USFWS refuge and regional staff. Plant specimens were identified by Idaho F&G ecologists. Each plot from the 2009 study and 2011 data (species and abundance) was reviewed by NatureServe ecologists and placed into appropriate level of the NVC. No quantitative analysis was conducted. One hundred twenty-nine plant taxa were observed in 2011. This brings the total taxa known to occur at Camas to 232 (combined 2008, 2009 and 2011 data). Of these 150 are native to North America, 77 are non-native species, and 5 taxa are undetermined.

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Ten NVC Groups were identified, including 6 wetland groups and 4 upland groups. Wetland Groups include emergent marshes, alkaline meadows, riparian shrublands, mudflats and wet meadows of native and non-native species. Upland Groups were comprised of sagebrush steppe and sagebrush shrublands, rabbitbrush shrublands, native desert grasslands, and non-native dry meadows and grasslands. Within these Groups 19 alliances were identified, including 14 known alliances from western US and 9 new, ruderal (non-native) types were described and documented. Ruderal vegetation types are those dominated by species not native to North America. In addition, 19 plant associations were also identified. Five new plant associations were described from Camas and are considered provisional additions to the NVC until accepted by the peer review process.

Of the wetland types found at Camas, the following alliances are believed to be native to Camas prior to European settlement:

1. Alkaline-Saline Wet Meadow Group

- a. Salt Grass Herbaceous Alliance
- b. Alkali-Sacaton Grassland Alliance

2. Marsh Group

- a. Common Spike-Rush Herbaceous Alliance
- b. Hard-Stem Bull-Rush Herbaceous Alliance
- c. Broadleaf Cattail Herbaceous Alliance

3. Wet Meadow Group

- a. Sedge (wheat, clustered field, Northwest Territory) Montane Wet Meadow Alliance

4. MudFlat Group

- a. Amaranth (California, Green) Mudflat Sparse Herbaceous Alliance

5. Woody Riparian Group

- a. Coyote Willow Shrubland Alliance

While cattail and bulrush species are native, it is likely they were not as abundant as they are today. An interesting botanical find was a new county record for *Carex atherodes* (wheat sedge, NRCS Code CAAT2). This is also one of the new associations identified at Camas. While documented in 2011, this species was also observed in 2009 (Germino 2010).

One very abundant alliance, the Baltic Rush Alliance, is dominated by a native species that increases with disturbance, such as heavy grazing pressure. Several areas sampled were classified to this type, but

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had many other native graminoid species present. It may be possible through management such as intensive localized grazing (high intensity low frequency) to reduce the abundance of Baltic rush and other less desirable species such as Canadian thistle, and increase the abundance of more desirable grasses and forbs (i.e. Wilson and Pärtel 2003, Bruijn and Bork 2005).

To assist with the communication and understanding of the concepts of this vegetation classification, USFWS Region1 Inventory and Monitoring biologist, Jenny Barnett, cross walked regional habitat names to NVC Groups. In addition, NVC Groups were cross walked to NatureServe Ecological System names. Ecological Systems are not part of the NVC but are closely related. Terrestrial ecological systems are defined as groups of plant community types that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. A given terrestrial ecological system will typically manifest itself in a landscape at intermediate geographic scales of 10s to 1,000s of hectares and persist for 50 or more years (Comer et al. 2003); hence they include seral stages as well as mature vegetation. For example at Camas there are both Rabbitbrush and Sagebrush Groups. Rabbit brush often increases in abundance after fire, so these two Groups are part of the same Inter-Mountain Basis Big Sagebrush Steppe ecological system. System names are provided here to show the relationship to the NVC, and so users can compare the Camas map with other regional and national products such as LANDFIRE (<http://www.landfire.gov/vegetation.php>). An illustrated key to the NVC Groups and Alliances found at Camas was provided for map accuracy assessment field work (see Appendix 1). NatureServe also provided descriptions of each NVC Group. Jenny Barnett added basic wildlife/habitat relationship information to these Group descriptions (see Appendix 3).

Map classes used for the Camas vegetation map are NVC Groups and NVC Alliances with additional classes for non-vegetated features such as roads, buildings and open water. Table 3 provides a list and brief description of each map class in the final legend, at the finest level of mapping detail. Table 7 provides a full list of cross-walk to ecological systems, CCP habitats, and all levels of the NVC. (Note Table 7 is at the end of the document).

Remote Sensing Methods

The minimum mapping unit (MMU) for this mapping project was chosen to be .25 acres for wetlands, the same as the National Wetlands Inventory; 1.2 acres for uplands, the same as the National Park Service, and .1 acres for structures.

Field work for the mapping occurred parallel to the vegetation classification field work described above. In addition to the EIA and vegetation classification points, a number of GPS points were obtained across the refuge, simply classing the point to the appropriate legend class in Table 3. The points were collected in two ways. First, while driving from location to location, the mapping analyst recorded roadside observations for classes that were discernible from windshield surveys ("Road Observations" in Figure 4). Points were recorded on a laptop to guide office work. Second, a number of points were collected in the field by walking from areas off the road ("Field Observations" in Figure 4).

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The remote sensing methodology was based upon using an automated statistical classifier to develop a base map for further photo interpretation. The general thinking that dictated the methodology is that the statistical classifier gets the mapper about 50% of the way to the final product, but significant photo interpretation and field work needs to occur to develop the vegetation map with higher accuracy. The following describes imagery sources, segmentation, classification, and photo interpretation.

Imagery Sources

The principal imagery source was 1 meter aerial photography from the National Agricultural Imagery Program (NAIP). The most recent imagery was from 2011. However, this was an extremely wet year. Relying only on this year of imagery would have over mapped water. Therefore, imagery from 2006 and 2009 were included in the mapping.

Light Detection and Ranging (LiDAR) data were also used. LiDAR data were captured in November 2011. The LiDAR provided another dimension of vegetation height and topography to assist in the mapping. The vegetation height data was provided by the contractor, Watershed Sciences. The main topographic variable of interest was topographic position. A topographic position index (TPI) was developed using the Land Facets Corridor Designer extension. The TPI assesses a pixel in the LiDAR-derived Digital Elevation Model (DEM) and assesses its position within a moving window. Higher values indicate that the pixel is on a ridge, lower value pixels indicate the pixel is in a depression. The moving window radii used were 250 and 500 meters. TPI was found to be useful in delineating upland vs. wetland.

Image Processing and Classification

Image segmentation is the process of clumping raster pixels with similar values into relatively homogenous vector polygons. The software program eCognition was used for image segmentation. A scale variable of 175 was used to develop polygons of sizes that approximated the Minimum Mapping Unit of .25 acres in wetlands. This produced over 16,000 individual polygons. Three dates of imagery (2006, 2009, 2011) and the LiDAR derived vegetation height and topographic position indices (250 and 500 meter radii) were the raster-based inputs to the segmentation algorithm.

The final segments were exported from eCognition, along with attribute fields for each raster band. These attribute fields are: minimum, maximum, mean, and standard deviation values for each band of NAIP imagery; along with minimum, maximum, mean, and standard deviation for vegetation height and the TPIs. The segments were also given attribute values associated with SSURGO soils and NWI polygons that overlap, providing some further ancillary information. This database of attribute values for each polygon was used for the remote sensing classification.

A Random Forest (Gislason *et al*, 2006) classifier was chosen because it provides a supervised approach to “mine” the complexity of multiple types of data (continuous and thematic) in order to predict classes. A training data set of 193 points was developed from field-based observations and photo interpretation. The Random Forest classifier from Weka (<http://www.cs.waikato.ac.nz/ml/weka/>) statistical program was used. Weka provides a simplified version of the more robust R-based Random Forest. The number of trees used was 100 and the seed value was 1. The initial results from the classifier were deemed adequate to provide a base for photo interpretation. In other words, upon visual inspection, it appeared that distinct features in the landscape were classified to the correct class. However, there was

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significant confusion between spectrally and topographically similar types. For example, upland shrub appeared to be adequately mapped, but there was confusion between sage and rabbitbrush. The input Weka data file is located with the final deliverables to the Region 1 I&M program. Those interested could open this file to view the details of the classifier.

The results were output to an ESRI Geodatabase for further photo interpretation. Approximately 1 day was spent doing the statistical classification and about 1 week was spent on photo interpretation. Photo interpretation methods involved overlaying the eCognition-based polygons on top of multiple dates of imagery and LiDAR. LiDAR and vegetation height data were particularly useful in visually distinguishing shrub vs. grassland classes.

Map Validation

A validation field trip was conducted in late June-early July, 2012. The mapping analyst spent 6 days reviewing a draft map in the field. The purpose was to field-test the map and see how well the draft represented ground characteristics. There were no formal protocols involved, other than to focus on areas that the mapping analyst had questions about.

Image segments, classified and labeled using methods described above were visited and assessed for accuracy. If the map call was correct, a note was taken on the polygon using ArcPad. If not, then the correct call was given for review in the office. A total of 901 rapid observations were made (Figure 5).

Map Finalization

The map was finalized in the office during August-September 2012. About one week of time was spent systematically going through validation points, field, and air photos to fix errors in the map. Air photo interpretation typically occurred at the scale of 1:5,000.

Beyond the NVC-based mapping, each polygon has a minimum, maximum, mean, and standard deviation vegetation height measure, based upon the LiDAR data. This was completed using the zonalstatistics commands in ArcGIS. Each sagebrush polygon also has a percent sagebrush cover metric. Accuracy was not assessed for these remote measurements.

The amount of each vegetation cover type was computed for the finest levels of the map legend (Table 6), and for CCP Habitat types (Table 5).

Accuracy Assessment

A field-based accuracy assessment was completed in July 2012. Prior to the field trip, we identified a number of points to visit. These points were identified through a stratified random sample.

The Surveying team consisted of Gwen Kittel, Senior Ecologist from NatureServe; Brian Wehausen, Camas NWR Manager; and Pam Johnson, Camas NWR Biologist. Over the course of the field assessment, surveyors were given a series of points to collect. The surveyor navigated to the field point using a Trimble 6000 GPS unit. When the surveyor was within 1-2 meters of the point, they used the Camas NWR vegetation key (Appendix 1) to label a point with a map class. 5 photos were taken of the point, one in each cardinal direction, and 1 towards the ground.

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If there was some confusion regarding which mapping class the vegetation should go into, secondary, and if necessary, tertiary calls were made. For example if it was not clear that a particular vegetation patch was Baltic Rush, or Ruderal Wet Meadow, then both were recorded. In the final accuracy assessment, both would be considered “acceptable” calls.

All points were collected into a database and intersected with the final vegetation polygons. Initially, Germino’s 2009 data were to be included in the accuracy assessment. However, this was problematic since the data were actually 100 meter transects, and not useful for a polygon based accuracy assessment since the data covered multiple polygons. We used Pam Johnson’s field points of crested wheatgrass and native sage communities to augment our crested wheatgrass and sagebrush points. This gave us an AA data set of 210 points.

Not all map classes had reported map accuracy. There are a variety of reasons for this, reported in the following table.

Results

The final confusion matrix is in Table 8. The overall accuracy of the map at the finest mapping level was 74.8%. There are several sources of confusion between mapping classes that are typical in vegetation mapping. Typical sources of confusion are classes that are similar in physiognomy or spectral response, and mapping classes that are spatially tightly interdigitated.

The “Producer’s Accuracy” results from dividing the number of correctly classified polygons in each category by the number of reference polygons of that class (the column total). This value represents how well reference polygons of the ground cover type are classified. Errors associated with producer’s accuracy are known as “errors of omission”. The “User’s Accuracy” results from dividing the number of correctly classified polygons in each category by the total number of polygons that were classified in that category. This represents the probability that a polygon classified into a given class actually is that class on the ground. Errors associated with user’s accuracy are known as “errors of commission”.

Some map classes were not reported on, because there were only 2 or less points. These are:

Amaranth (California, Green) Mudflat Sparse Herbaceous Alliance	Only 1 point
Sparse Vegetation/Rock	Only 1 point
Senescent Bulrush (litter)	No points
Active River Channel	No points
Planted Trees: Shelter Belt	No points
Naturalized Crack Willow	Only 1 point
Naturalized Russian Olive	No points
Agriculture	No points

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Developed: Roads & Buildings	No points
Open Water	Problematic from an AA perspective due to shifting distribution of open water.

Overall, the percent area of assessed map classes is over 95%, indicating that most of the mapping area is assessed for accuracy.

User's Accuracy

Six NVCS classes fell below 80% user's accuracy. The Baltic Rush alliance, one of the most abundant vegetation types on Camas NWR, had a user's accuracy of 73.2%. Baltic Rush is also found in a variety of different environmental settings, from broad expanses of meadows to areas fringing marshes, and small depressional wetlands. It is not surprising to see the mapping confusion spread across several different other classes. The mapping confusion with the marsh systems is apparent in 5 mapped polygons of Baltic Rush actually in the field being either Bulrush (4) or common spike-rush (1). Mapping confusion is due to these types being in similar ecological settings and probably from the confounding influence of water signatures. Another class that was confused with Baltic Rush was Ruderal Wet Meadow. Again, these types are frequently found in similar settings, with perhaps the Baltic Rush receiving more water. In large expanses of the refuge, they inter-mingle, forming a matrix of a mixture of Baltic Rush and ruderal types. Lastly, Baltic Rush was confused with Inter-mountain Semi-Desert Grassland. The source of confusion is likely the similar physiognomy and spectral responses of the two classes. While the Semi-Desert Grassland occurs on uplands, the two classes can be spatially very close to each other. Vegetation types on the refuge can change within a few meters in this landscape of low relief.

Great Basin & Intermountain Ruderal Dry Shrubland & Grass was confused, from a user's perspective, with other classes of similar physiognomy, crested wheatgrass and ruderal wet meadow. This indicates the limitation of distinguishing grass types across the landscape. There was also one erroneous point with the riparian willow.

The main source of confusion with the Green Rabbitbrush Shrubland and Steppe Alliance was with Intermountain Semi-Desert Grassland & Steppe Group. Both types occur in similar settings, upland swales. The height of the rabbitbrush can often be the same as surrounding grasslands, making it difficult to distinguish using LiDAR or air photo interpretation. It was somewhat surprising to note the error with common spike-rush.

The Hard-Stem Bull-Rush Herbaceous Alliance was mostly confused the Broadleaf Cattail. This is not surprising, given the similar ecological setting, height, and appearance on imagery. Other errors with the Bulrush were with Baltic Rush and Ruderal Wet Meadow.

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Producer's Accuracy

Seven of the mapping classes were below 80% in Producer's accuracy. For classes that had less than 80% accuracy in the user's accuracy (above), similar sources of confusion were found, and will not be repeated here. For other classes, this section assesses potential reasons for error.

The Native Sedge Montane Wet Meadow Alliance only had 3 accuracy assessment points associated with it. Of those three, one was correct. The confusion with Bulrush is somewhat understandable. The area in which the Native Sedge Montane Wet Meadow Alliance occurs is generally located within a mosaic of marsh and wet meadow components. The confusion with rabbitbrush is surprising and indicates a problem with distinguishing upland vs. wet meadow in a very flat environment.

The other class not covered in the User's accuracy discussion is the Western North American Ruderal Wet Meadow & Marsh Group. It had a producer's accuracy of 78.8%. The largest source of confusion was with Baltic Rush, which is understandable given how interdigitated these classes are across the refuge landscape.

Overall accuracy close to 75% is quite good for a map to this level of detail. The reported accuracy is for the finest level of class distinction. If the map and points were rolled up into the group, macrogroup, or ecological system level, we would expect higher accuracies.

Conclusion

The vegetation of Camas National Wildlife Refuge was mapped during the years of 2011-2012 following a rigorous methodology of field-based vegetation classification, remote sensing methods including image segmentation and RandomForest classifiers, about one week of photo interpretation, followed by a one week field validation. A field-based accuracy assessment was conducted.

The map has an overall accuracy of 74.8% at the finest level of mapping detail, a hybrid group and alliance classification. This level of accuracy and detail should provide managers and planners with a new level of information to visualize and develop alternatives over the entire refuge. Over time, this map should be updated to reflect changing conditions. The map should be of high enough quality and detail to allow refuge or I&M staff to update the map without recreating it.

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Table 1. Description of NVCS Hierarchy with Examples from Camas NWR

Hierarchy Level	Description of the Hierarchy Level	Examples from Camas NWR
Upper Level: Physiognomy plays a predominant role.		
L1 – Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.	Shrubland & Grassland
L2 – Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions.	Temperate & Boreal Grassland & Shrubland
L3 – Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.	Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Mid Level: Floristics and physiognomy play predominant roles		
L4 – Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	Western North American Freshwater Shrubland, Wet Meadow & Marsh
L5 – Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	Western North American Temperate Lowland Wet Shrubland, Wet Meadow & Marsh
L6 – Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology and disturbance regimes.	Western North American Temperate Interior Freshwater Marsh
Lower Level: Floristics plays a predominant role		
L7 – Alliance	A vegetation classification unit containing one or more associations, with a defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the upper most or dominant stratum of the vegetation (Jennings et al. 2009).	Common Spikerush Herbaceous Alliance
L8 – Association	a vegetation classification unit defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy (Jennings et al. 2009)	Common Spikerush Herbaceous Vegetation

Camas NWR Vegetation Inventory, Classification, and Mapping

Table 2. Alliances and Associations surveyed on Camas NWR.

Group Colloquial Name	NVC Alliance Name	NVC Alliance Common Name	NVC Plant Association
Marsh	<i>Eleocharis palustris</i> Herbaceous Alliance	Common Spike-Rush Herbaceous Alliance	<i>Eleocharis palustris</i> Herbaceous Vegetation
	<i>Schoenoplectus acutus</i> Herbaceous Vegetation Alliance	Hard-Stem Bull-Rush Herbaceous Alliance	<i>Schoenoplectus acutus</i> Herbaceous Vegetation
	Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semipermanently Flooded Herbaceous Alliance	Broadleaf Cattail Herbaceous Alliance	Classified to Alliance level only
Wet Meadow	<i>Juncus balticus</i> Herbaceous Alliance	Baltic Rush Herbaceous Alliance	<i>Juncus balticus</i> Herbaceous Vegetation
	Carex (atheroides, praegracilis, utriculata) Montane Wet Meadow Alliance	Sedge (wheat, clustered field, Northwest Territory) Montane Wet Meadow Alliance	<i>Carex atherodes</i> Herbaceous Vegetation
			<i>Carex utriculata</i> Herbaceous Vegetation
			<i>Carex praegracilis</i> Herbaceous Vegetation
Mudflat	Amaranthus (californica, powellii) Sparce Mud Flat Alliance	Amaranth (California, Green) Mudflat Sparse Herbaceous Alliance	Amaranthus californica Mudflat Herbaceous Vegetation
Woody Riparian	Salix exigua Shrubland Alliance	Coyote Willow Shrubland Alliance	Salix exigua / Mesic Forbs Shrubland
			Salix exigua / Eleocharis palustris Shrubland

Camas NWR Vegetation Inventory, Classification, and Mapping

Group Colloquial Name	NVC Alliance Name	NVC Alliance Common Name	NVC Plant Association
Non-Native Mesic-Wet Meadow	Cirsium arvense - Lactuca serriola - Thlaspi arvense Ruderal Mesic-Wet Forb Alliance	Canadian Thistle - Prickly Lettuce - Field Pennycress Ruderal Mesic-Wet Herbaceous Alliance	Classified to Alliance level only
	Elymus repens (=Agropyron repens) Ruderal Graminoid Alliance	Quack grass Ruderal Grassland Alliance	Classified to Alliance level only
	Chenopodium (glaucum, alba) - Salsola kali Ruderal Salt Flat Forb Alliance	Oakleaf Goosefoot - Lamb's-Quarters - Russian-Thistle Ruderal Salt Flat Herbaceous Alliance	Classified to Alliance level only
Alkaline-Saline Wet Meadow	Sporobolus airoides Herbaceous Alliance	Alkali-Sacaton Grassland Alliance	Sporobolus airoides - Muhlenbergia asperifolia Herbaceous Vegetation
	Distichlis spicata Herbaceous Alliance	Salt Grass Herbaceous Alliance	Distichlis spicata Herbaceous Vegetation
Sagebrush Steppe	Artemisia tridentata spp. tridentata Shrub and Shrub Steppe Alliance	Basin Big Sagebrush Shrubland and Steppe Alliance	Artemisia tridentata spp. tridentata - Ericameria nauseosa /Bromus tectorum Semi-natural Shrubland
			Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland
Rabbitbrush Shrubland	Chrysothamnus viscidiflorus Shrubland and Shrub Steppe Alliance	Green Rabbitbrush Shrubland and Steppe Alliance	Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland
			Chrysothamnus viscidiflorus / Poa pratensis Semi-natural Shrub Herbaceous Vegetation

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Group Colloquial Name	NVC Alliance Name	NVC Alliance Common Name	NVC Plant Association
			Chrysothamnus spp / Pascopyrum smithii Shrubland
Desert Grassland	Agropyrum smithii (Pascopyrum smithii) Grassland Alliance	Western Wheatgrass Grassland Alliance	Pascopyrum smithii Herbaceous Vegetation
	<i>Hesperostipa comata</i> Semi- Desert Grassland Alliance	Needle-and-Thread Semi- Desert Grassland Alliance	Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation
			Hesperostipa comata - Poa secunda Herbaceous Vegetation
Non-Native Dry-Mesic meadow	<i>Bromus tectorum</i> Ruderal Graminoid Alliance	Cheat grass Ruderal Grassland Alliance	Classified to Alliance level only
	<i>Agropyron cristatum</i> Ruderal Grassland Alliance	Crested Wheatgrass Ruderal Grassland Alliance	Classified to Alliance level only
	<i>Sisymbrium altissimum- Descurainia sophia - Lappula occidentalis</i> Ruderal Forb Alliance	Tall Hedge-Mustard - Herb Sophia - Flat- Stickseed Ruderal Dry-Mesic Forb Alliance	Classified to Alliance level only

Table 3. Finest level of mapping units at Camas NWR. Full descriptions of Groups and Alliances are in appendices 3 and 4.

NVC Group Map Unit Name	Map Unit Name	Brief Description (Full descriptions of NVCS Groups in Appendix 2 and Alliances in Appendix 3)
Marsh	Common Spike-rush Herbaceous Alliance	Marsh dominated by common Spike-Rush
	Broadleaf Cattail Herbaceous Alliance	Marsh dominated by Cattail
	Hard-stem Bull-rush Herbaceous Alliance	Marsh dominated by bulrush
Wet Meadow	Baltic Rush Herbaceous Alliance	Baltic Rush is the dominant native. Occurs in several settings across the refuge.
	Native Sedge Montane Wet Meadow Alliance	Small patches dominated by a mix of native sedges
Rabbitbrush Shrubland	Green Rabbitbrush Shrubland and Steppe Alliance	Shrub cover dominated by green rabbitbrush
Sagebrush Steppe and Sagebrush Shrubland	Sagebrush / native grass	Big Sagebrush dominated by native grasses in the understory
	Sagebrush / non-native grass	Big Sagebrush dominated by non-native grasses in the understory
Desert Grassland	Desert Grassland	Typically, western wheatgrass dominated grassland
Woody Riparian	Coyote willow Shrubland Alliance	Riparian zone or lake fringe dominated by Coyote Willow
Mudflat	Amaranth (California, Green) Mudflat Sparse Herbaceous Alliance	A vegetated mudflat
Non-Native Mesic-Wet Meadow	Ruderal Mesic-Wet Meadow	A mix of non-native grasses and forbs

Camas NWR Vegetation Inventory, Classification, and Mapping

NVC Group Map Unit Name	Map Unit Name	Brief Description (Full descriptions of NVCS Groups in Appendix 2 and Alliances in Appendix 3)
Non-Native Dry-Mesic Meadow	Non-native Dry-Mesic Meadow	A mix of non-native grasses more upland, typically cheat grass.
	Crested Wheatgrass Ruderal grassland Alliance	Crested wheatgrass > 50% cover
Non-NVCS Mapping Classes	Sparse Vegetation/Rock	Less than 10% vegetated. In Camas NWR, this is isolated to a few rock outcrops in the sage steppe.
	Senescent Bulrush (litter)	Large patches of senescent. Typically, managed ponds that have not received water in recent years.
	Active River Channel	In imagery and in the field, the active channel of Camas Creek is seldom fully watered. It is a mix of bare soil/mud, and typical riparian
	Planted Trees: Shelter Belt	Cultural woody vegetation for habitat.
	Naturalized Crack Willow	Cultural woody vegetation
	Naturalized Russian Olive	Isolated to a few patches along riparian zones and ditches
	Agriculture	Pasture/Hay, and grain crops
	Developed: Roads & Buildings	Roads and structures on the refuge
	Open Water	Open water on several years of imagery.

Camas NWR Vegetation Inventory, Classification, and Mapping

Table 4. Crosswalk to CCP Habitat Types

Finest Level in the Vegetation Map Legend	CCP Habitat Type
Agricultural	Hay
Native Sedge Montane Wet Meadow Alliance	Wet Meadow
Crested Wheatgrass Ruderal Grassland Alliance	Upland Non-Native
Intermountain Semi-Desert Grassland & Steppe Group	Shrub Steppe
Developed	Developed
Amaranth Mudflat Sparse Herbaceous Alliance	Open Water
Common Spike-Rush Herbaceous Alliance	Hemi-Marsh
Western North American Ruderal Wet Meadow & Marsh Group	Lowland Non-Native
Baltic Rush Herbaceous Alliance	Wet Meadow
Open Water	Open Water
Cultural Woody Vegetation	Shelterbelt
Green Rabbitbrush Shrubland and Steppe Alliance	Shrub Steppe
Russian Olive Alliance	Riparian
Narrow-Leaf Willow Shrubland Alliance	Riparian
Hard-Stem Bull-Rush Herbaceous Alliance	Hemi-Marsh
Non-Vegetated	Shrub Steppe
Broadleaf Cattail Herbaceous Alliance	Hemi-Marsh
Crack Willow Alliance	Shelterbelt
Senescent Vegetation Dominant (Litter)	Hemi-Marsh
River Bottom Active Channel, Transitionally Vegetated	Open Water
Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native	Shrub Steppe
Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal	Shrub Steppe
Great Basin & Intermountain Ruderal Dry Shrubland & Grass	Upland Non-Native

Table 5. Acres of CCP Habitat Types

CCP Name	Acres
Developed	100.2
Hay	328.2
Hemi-Marsh	841.0
Lowland Non-Native	2746.8
Open Water	735.6
Riparian	279.3
Shelterbelt	33.9
Shrub Steppe	2622.6
Upland Non-Native	1113.6
Wet Meadow	1958.1

Camas NWR Vegetation Inventory, Classification, and Mapping

Table 6. Acres of the finest mapping levels

Macro-Group	Finest Mapping Level	Acres
Cultural Woody Vegetation	Crack Willow Alliance	9.7
	Cultural Woody Vegetation	33.9
	Russian Olive Alliance	1.8
Great Basin & Intermountain Dry Shrubland & Grassland	Green Rabbitbrush Shrubland and Steppe Alliance	470.6
	Intermountain Semi-Desert Grassland & Steppe Group	209.2
Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native	1749.9
	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal	191.6
Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland	Amaranth Mudflat Sparse Herbaceous Alliance	256.8
	Baltic Rush Herbaceous Alliance	1950.0
	Broadleaf Cattail Herbaceous Alliance	51.6
	Common Spike-Rush Herbaceous Alliance	256.9
	Hard-Stem Bull-Rush Herbaceous Alliance	485.1
	Narrow-Leaf Willow Shrubland Alliance	277.5
	Native Sedge Montane Wet Meadow Alliance	8.1
Western North American Ruderal Macro-Groups	Crested Wheatgrass Ruderal Grassland Alliance	983.9
	Great Basin & Intermountain Ruderal Dry Shrubland & Grass	129.8
	Western North American Ruderal Wet Meadow & Marsh Group	2746.8
Non-NVCS	Agricultural	328.2
	Developed	100.2
	Intermountain Basins Cliff, Scree & Badland Sparse Vegetation	1.4
	Senescent Vegetation Dominant (Litter)	37.7
	Open Water	439.0
	River Bottom Active Channel, Transitionally Vegetated	39.8

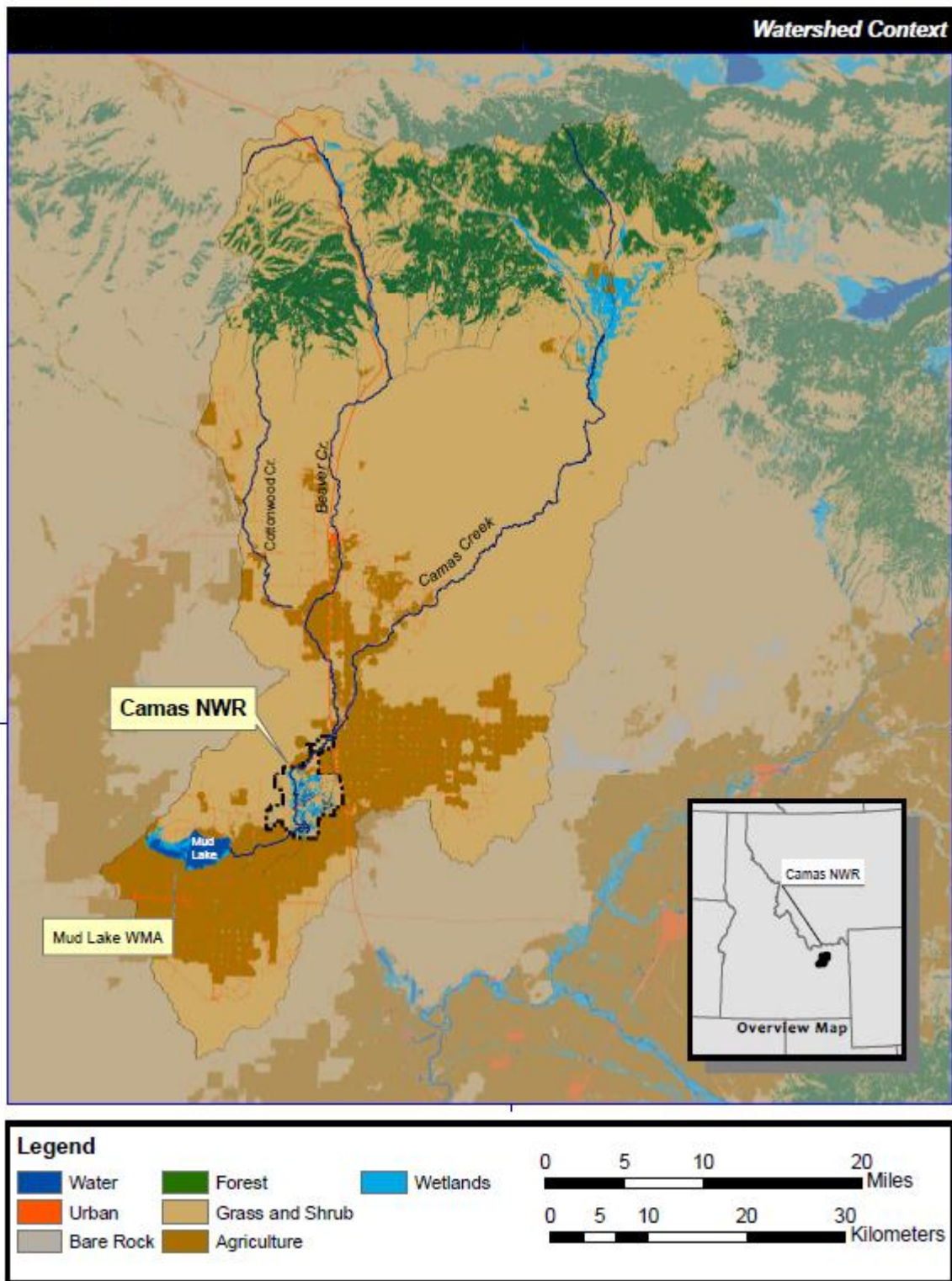
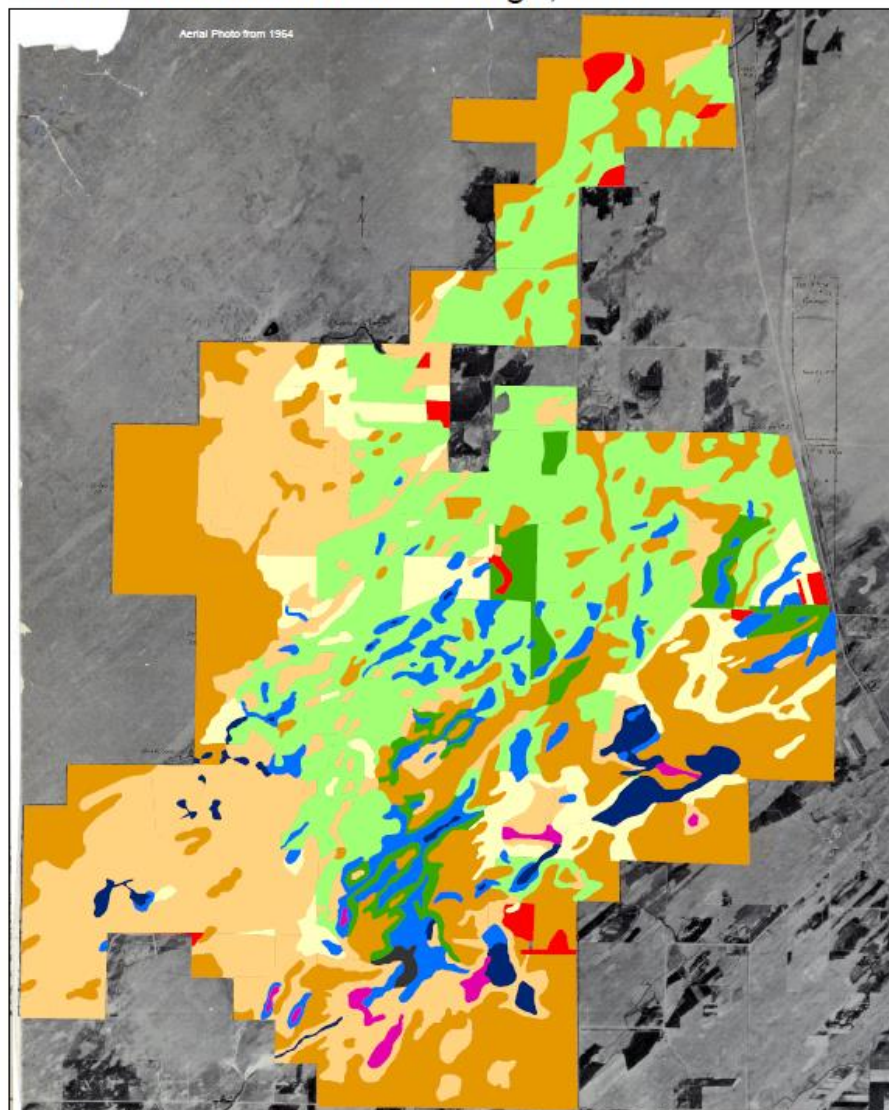


Figure 1. Location of Camas NWR

Camas NWR Vegetation Inventory, Classification, and Mapping

Camas National Wildlife Refuge, 1936



Legend

- Agriculture: The entire acreage is usually devoted to grain crops and the average yield is estimated to be 25 bushels per acre.
- B
- Grazing No. 1: This type is composed of well sodded grass areas adjacent to marshes which generally would produce hay if protected from grazing.
- Grazing No. 2: This type is only slightly less valuable than grazing No. 1 type, the main difference being the quality of the forage available
- Grazing No 3: While this land at first glance seems to have but little value, careful examination will reveal considerable palatable grass scattered through the predominating sagebrush.
- Hay Tame: This is essentially the same type as Agriculture. In this instance the yields are used for feed, and little seed is harvested.
- Hay Wild: There are approximately 980 acres of wild hay. The quality is very good due to the past practice of drilling in redtop, clover, and timothy seed or broadcast seeding small quantities from year to year.
- Marsh: The marsh type is dry during the late summer as a rule due to irrigation from wells reducing the water table.
- MF
- Water: The water areas fluctuate with the season. During the summer some forage is obtainable from the annual weeds in the dry lake beds

Figure 2.. Vegetation map from 1936.

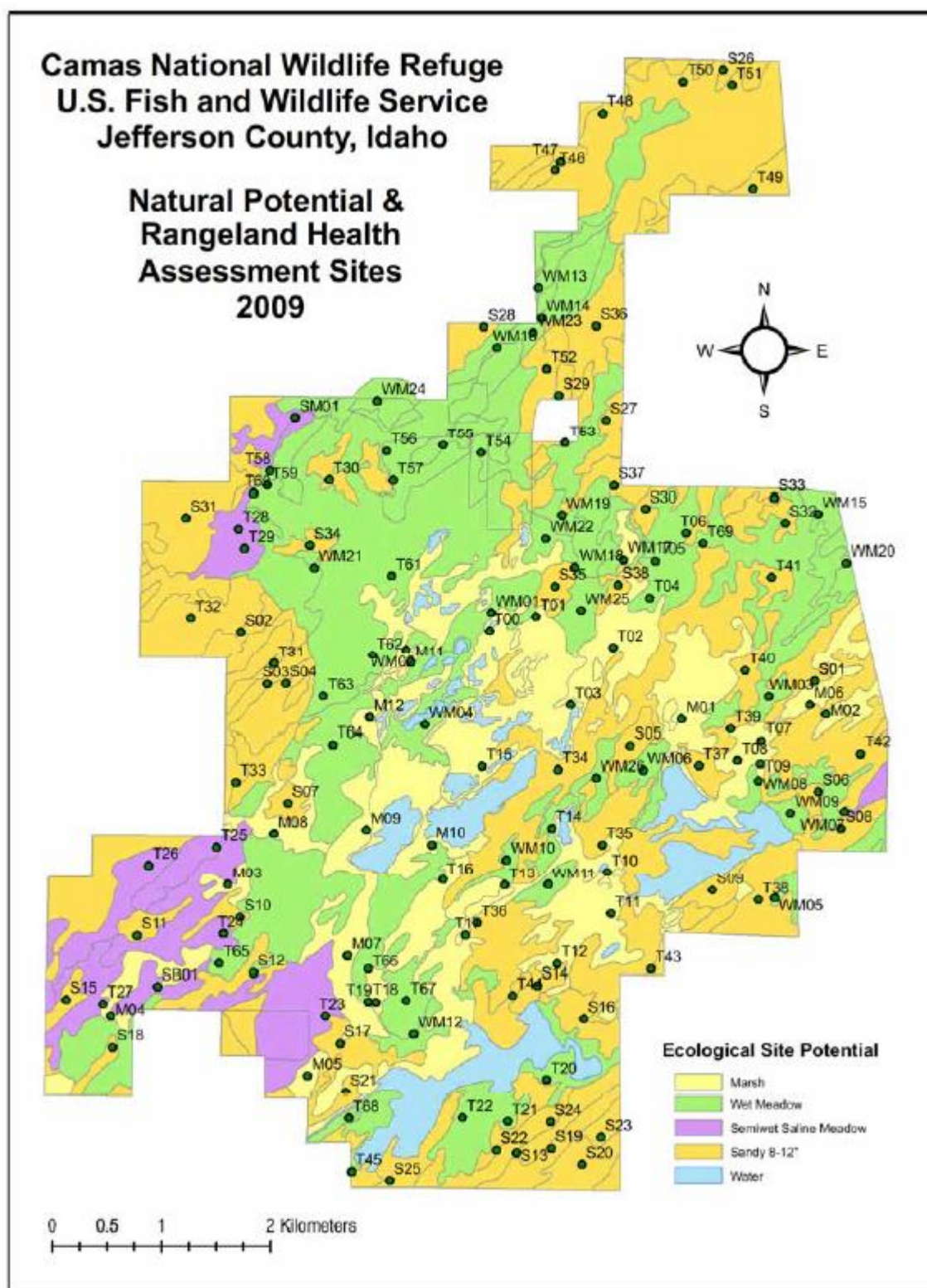


Figure 3. Germino's 2009 – 2010 range health assessment map showing Ecological Site Potential classes used in stratified random sample, and locations of Germino's field plots. .

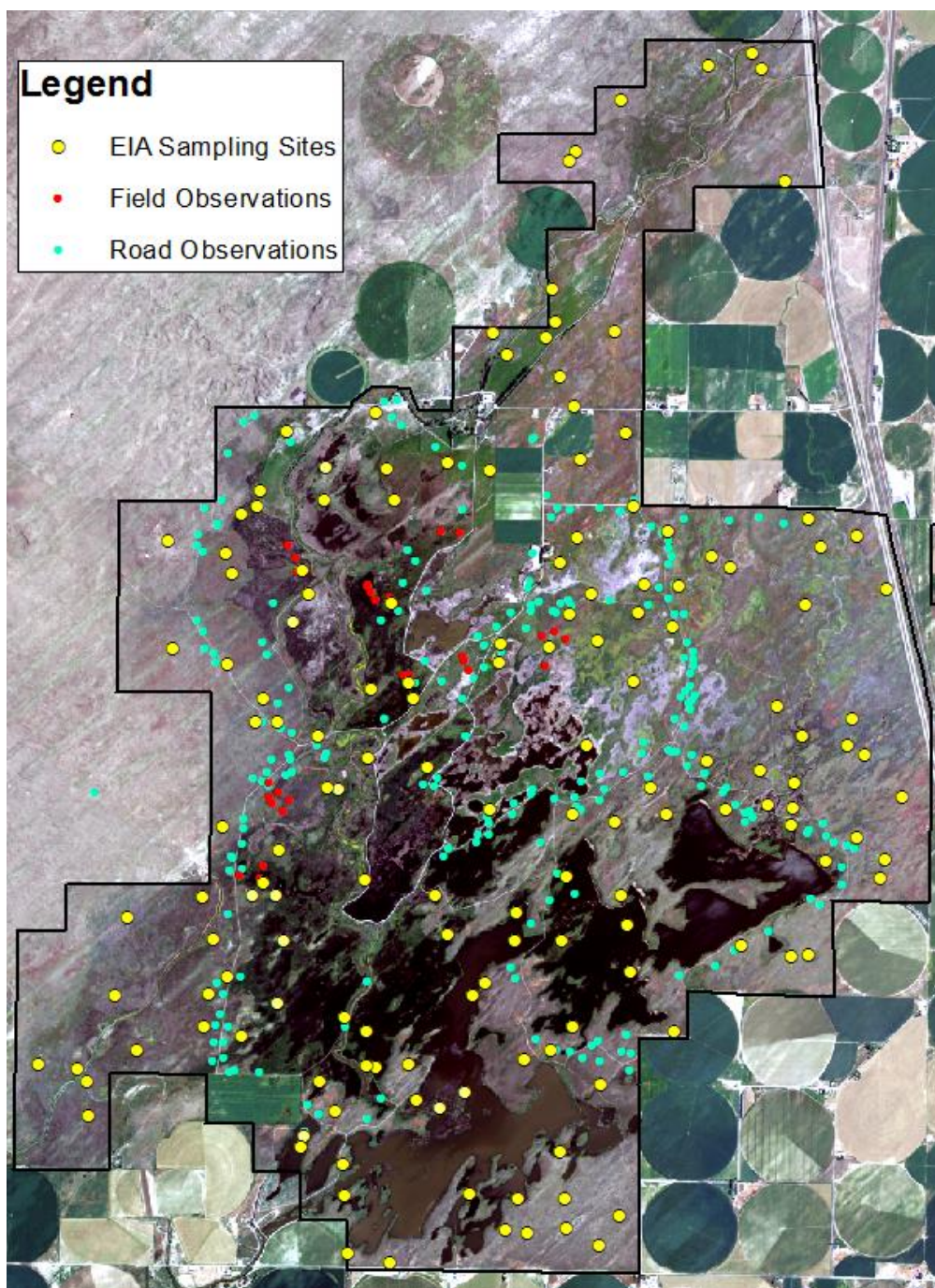


Figure 4. Location of EIA sampling sites, "field observations" for mapping, and "road observations" taken from a vehicle.

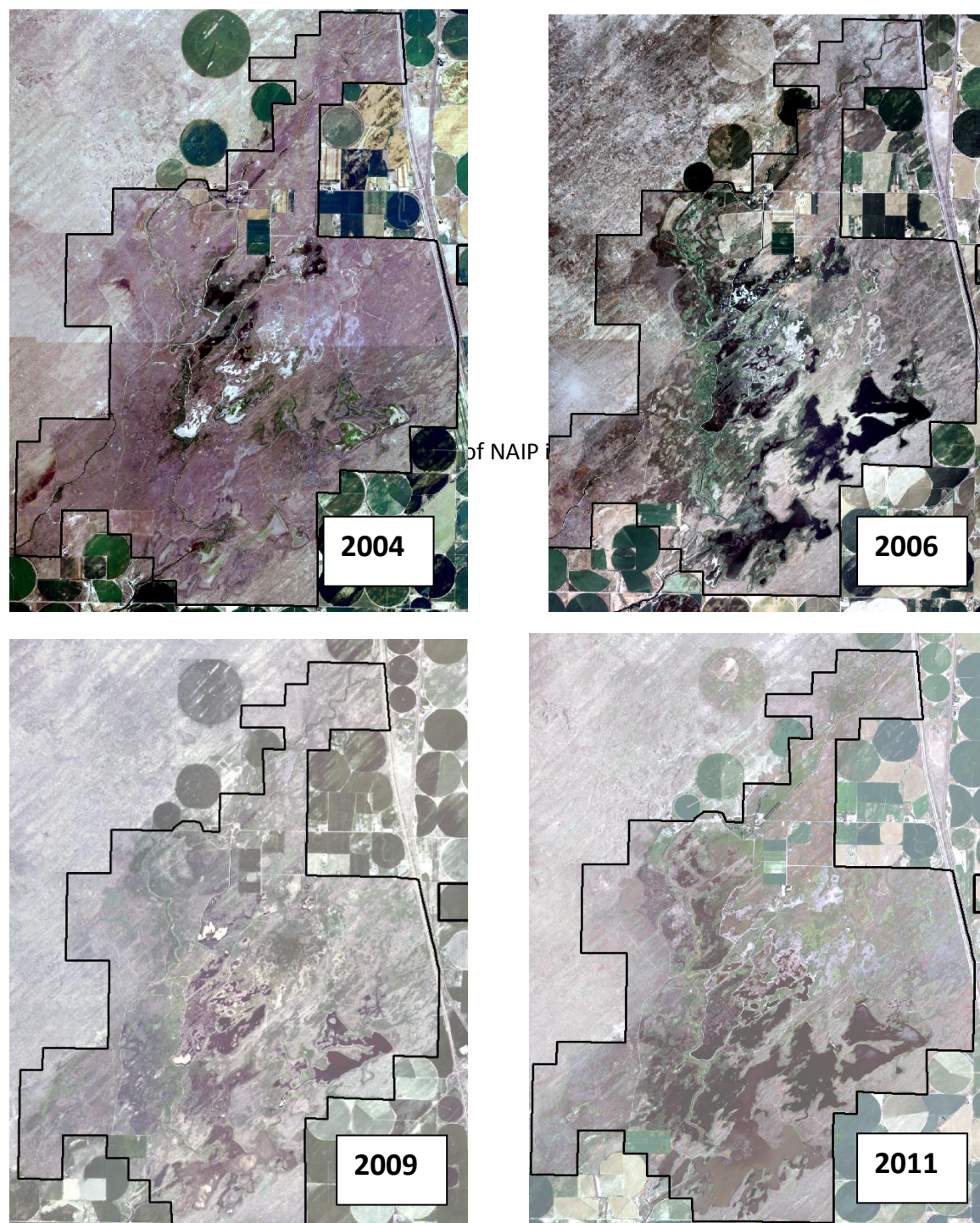


Figure 5. Spatial change in water over 4 years of NAIP imagery.

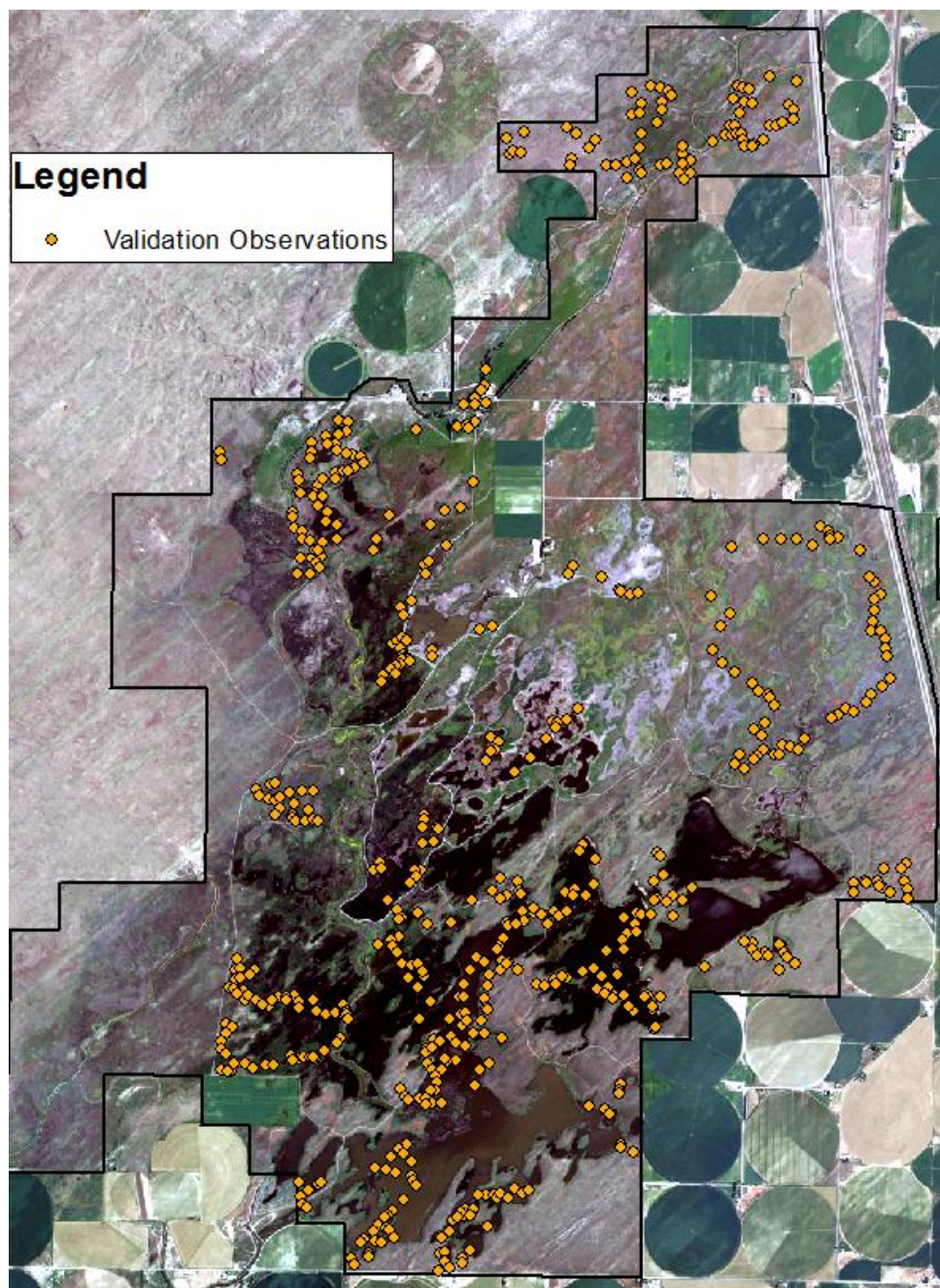


Figure 7. Location of point locations used to validate the accuracy of a draft map.

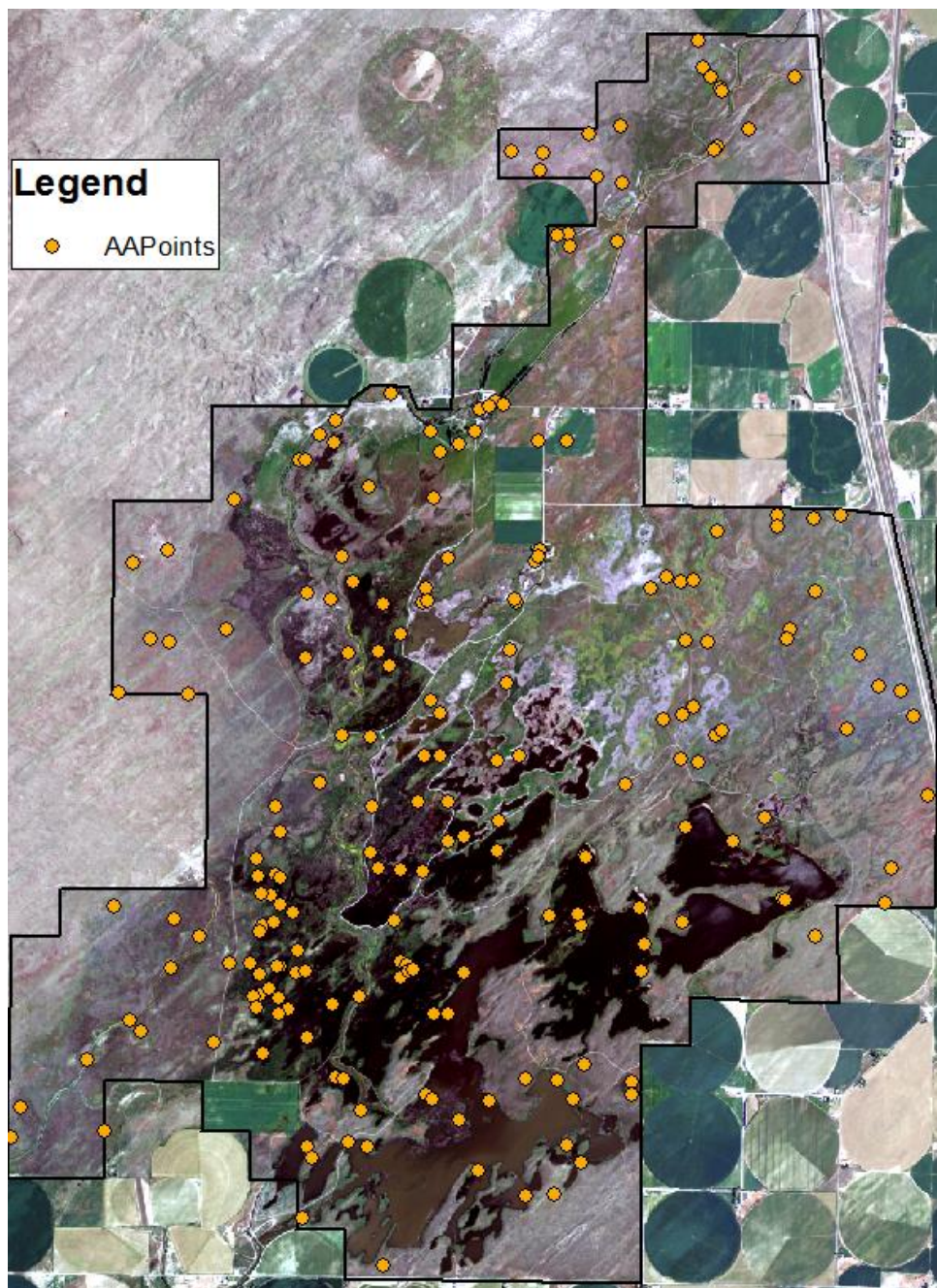


Figure 8. Location of accuracy assessment points from the June/July 2012 field assessment.

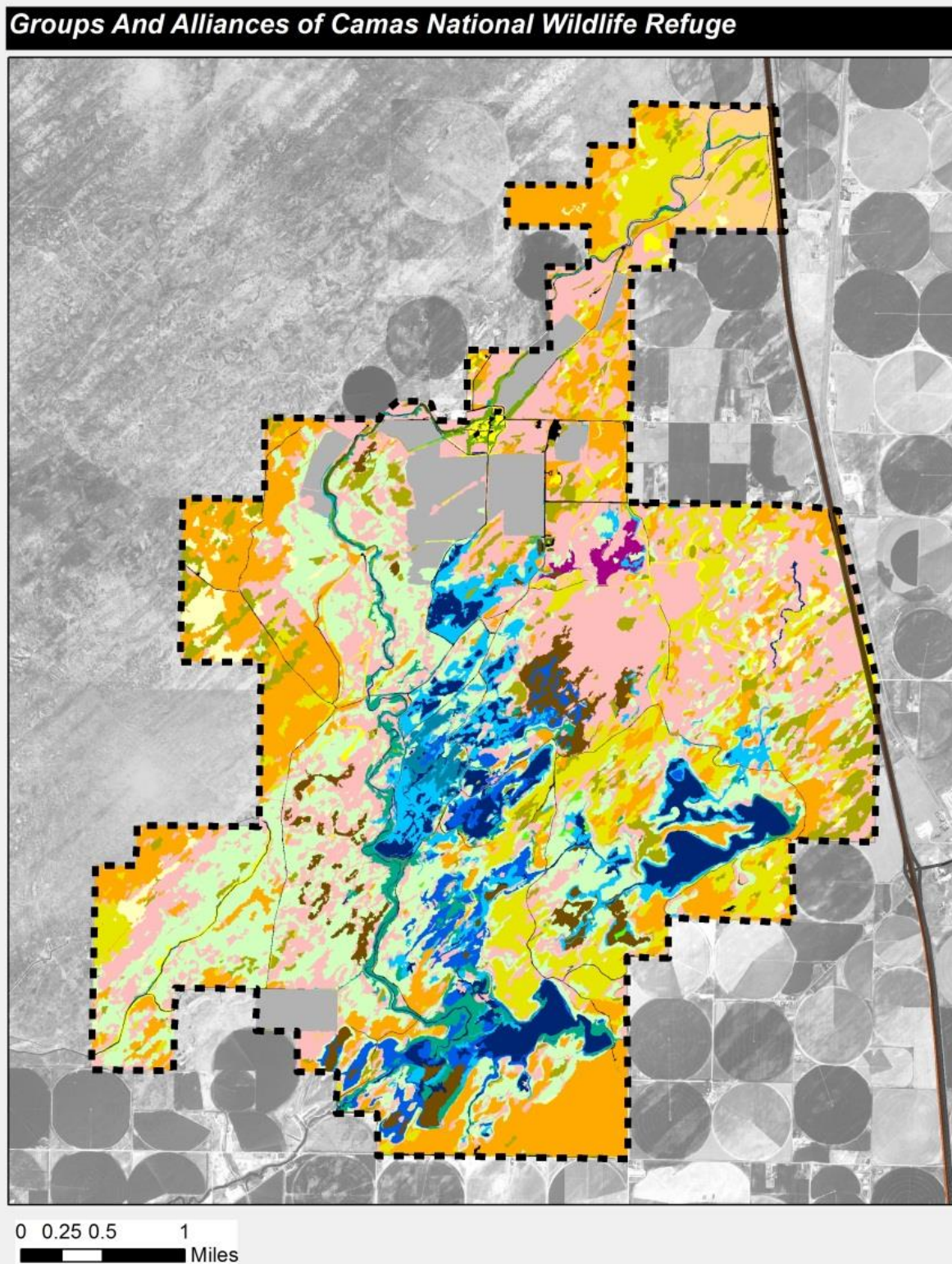


Figure 9. Final map of Groups and Alliances of Camas National Wildlife Refuge.

Camas NWR Vegetation Inventory, Classification, and Mapping

Legend

	Open Water, Most Years
	River Bottom Active Channel, Transitionally Vegetated
	Amaranth Mudflat Sparse Herbaceous Alliance
	Broadleaf Cattail Herbaceous Alliance
	Common Spike-Rush Herbaceous Alliance
	Hard-Stem Bull-Rush Herbaceous Alliance
	Native Sedge Montane Wet Meadow Alliance
	Baltic Rush Herbaceous Alliance
	Western North American Ruderal Wet Meadow & Marsh Group
	Narrow-Leaf Willow Shrubland Alliance
	Crested Wheatgrass Ruderal Grassland Alliance
	Great Basin & Intermountain Ruderal Dry Shrubland & Grass
	Green Rabbitbrush Shrubland and Steppe Alliance
	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native
	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal
	Intermountain Semi-Desert Grassland & Steppe Group
	Agricultural
	Cultural Woody Vegetation
	Crack Willow Alliance
	Russian Olive Alliance
	Non-Vegetated
	Senescent Vegetation Dominant (Litter)
	Developed
	Refuge Boundary
	Inholding

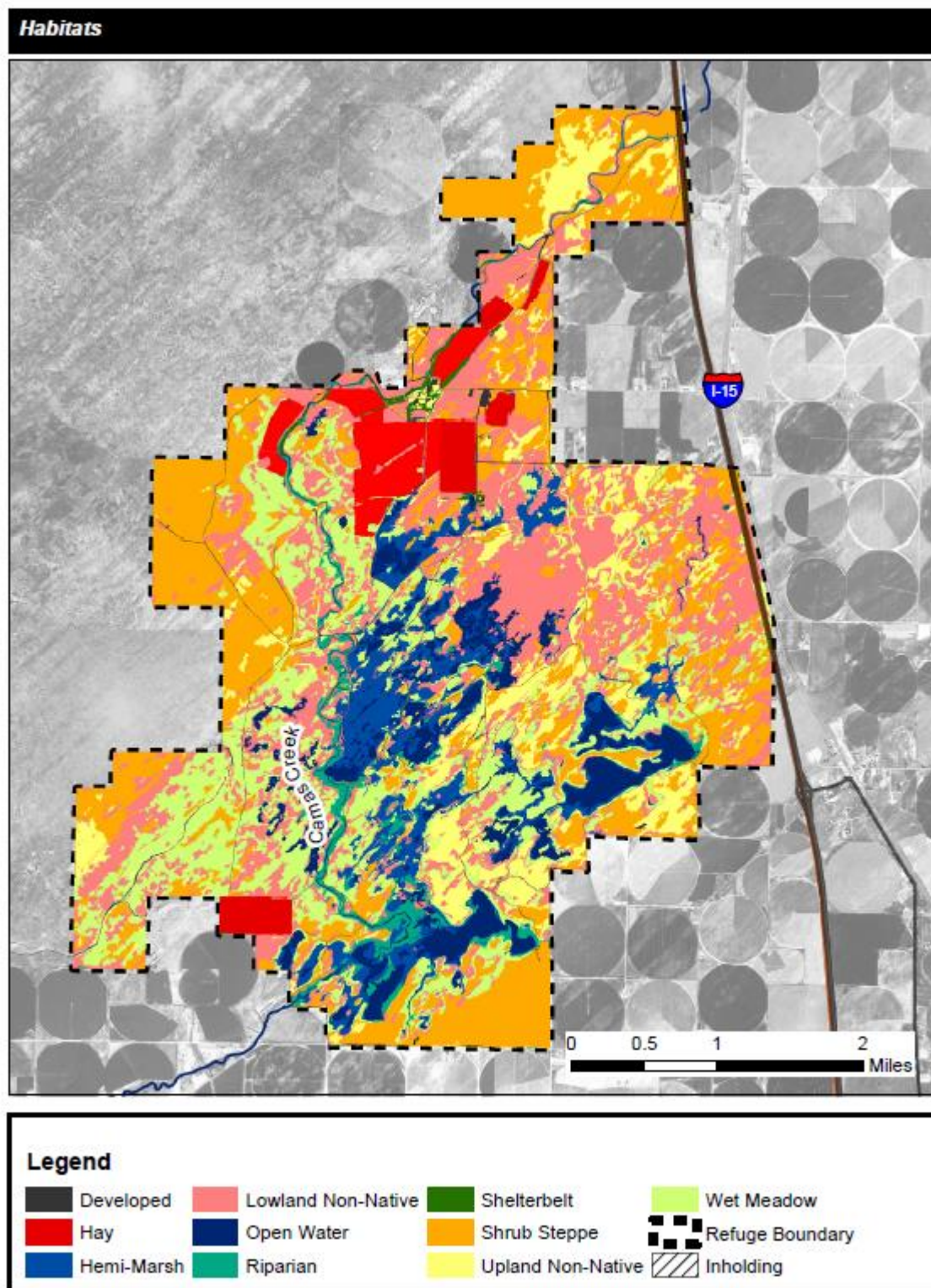


Figure 10. Vegetation database crosswalked to CCP Habitats

Appendix 1: Key to Groups and Alliances of Camas National Wildlife Refuge

Key to Camas NWR Mapped NVC Groups and Alliances

The following key is a key to Groups and alliances for Camas NWR.

1. Vegetation of trees that form a canopy of 5' or taller, individual or stands of trees **I. Forest and Woodland**
2. Vegetation dominated by shrubs covering at least 10% of the ground (if shrub cover is boarder-line, key both as a shrubland and as herbaceous type) **II. Shrubland**
3. Vegetation dominated by herbaceous species with at least 10%, may be lower at the edges of water bodies, or on patches of bare rock or sand as inclusions with the assessment area..... **III. Herbaceous**
4. Vegetation is less than 10% vascular plant cover (discount any ichens or mosses) within the entire minimum mapping area (0.5 ha) **IV. Sparse**

I. Forest and Woodland Vegetation

- 1a. Forest and Woodlands or individual trees in all settings/habitats. All of the trees in and around the refuge compound and along the ditches were planted. These consist of trees and tall shrub species of: plains and black cottonwoods, green ash, box elder, hawthorn, Siberian pea, chokecherry, plum, sumac, buffalo berry, elderberry, whiplash willow, yellow willow and peachleaf willow **Cultural Woody Vegetation: Planted Trees (Shelterbelt)**
- 1b. Individual trees or groves of Russian Olive, both planted and spread by birds **Russian Olive**

II. Shrubland

- 1a. Vegetation dominated by woody plants in wetland or riparian areas 2
- 1b. Vegetation dominated by woody plants in dry upland areas..... 3
- 2a. Shrublands dominated by Coyote willow (also called sand-bar willow) (*Salix exigua*) ***Salix exigua* Shrubland Alliance**
- 2b. Shrublands dominated by other wetland or riparian shrub species **Rocky Mountain & Great Basin Lowland & Foothill Riparian & Seep Shrubland Group**
- 3a. Shrublands (shrub cover is >25% cover) or shrub steppe (open mix of shrub with at least 10% cover and grassland) – shrub cover is dominated by at sagebrush (*Artemisia spp.*) 4
- 3b. Shrublands or shrub steppe dominated by rabbitbrush (*Chrysothamnus viscidiflouris*) and *Artemisia* is not present..... 6
- 4a. Shrublands or shrub steppe dominated by big sagebrush (*Artemisia tridentata* ssp. *tridentata*) 5
- 4b. Shrubland or shrub steppe dominated by other sagebrush species (such as three-tip sagebrush, *A. tripartita*) or co-dominated with other species such as bitterbrush (*Purshia tripartita*)

Camas NWR Vegetation Inventory, Classification, and Mapping

..... Intermountain Dry Tall Sagebrush Shrubland & Steppe Group



- 5a. Shrublands or shrub steppe dominated by *Artemisia tridentata* with mostly native grasses (such as *Hesperostipa comata*) and forbs in the ground layer
 ***Artemisia tridentata* spp. *tridentata* Shrub and Shrub Steppe Alliance**
- 5b. *Artemisia tridentata* shrublands where crested wheatgrass (*Agropyron cristatum*) or cheatgrass (*Bromus tectorum*) has replaced the native herbaceous ground cover
 **Great Basin & Intermountain Ruderal Dry Shrubland & Grassland Group**
 ***Artemisia tridentata* spp. *tridentata* / *Agropyron cristatum* Semi-Natural Association**
 ***Artemisia tridentata* spp. *tridentata* / *Bromus tectorum* Semi-Natural Association**
- 6a. Shrublands or shrub steppe dominated by rabbitbrush (*Chrysothamnus* spp) *Artemisia* spp not present..... ***Chrysothamnus viscidiflorus* Shrubland and Shrub Steppe Alliance**
- 6b. Upland shrubland or shrub steppe dominated by other shrub species or otherwise not as above.....
 **Intermountain Semi-Desert Shrubland Group**

III. Herbaceous Vegetation

- 1a. Herbaceous vegetation in wetland or mesic habitats (marshes, wet meadows, freshwater or alkaline mudflats)..... 2
- 1b. Herbaceous vegetation in upland or mesic to dry habitats (grasslands, old fields) (when in doubt key both ways) 12

Wetland, marsh and Mesic Herbaceous Vegetation

- 2a. Marsh or wet meadow vegetation dominated native species such as reeds Bulrush, cattail, Spikerush, Baltic rush (also known as wire grass, *Juncus balticus*) or native sedges (*Carex* spp) ... 3
- 2b. Wet meadow or mudflat vegetation not like above 6

- 3a. Marsh vegetation dominated by reeds bulrush, cattails or Spikerush 4
- 3b. Wet meadow dominated by Baltic rush (wire grass) or native sedges 5

4. Western North American Temperate Interior Freshwater Marsh Group

- 4a. dominated by tall firm reeds (>2 feet tall) bull rush ***Schoenoplectus acutus* Herbaceous Alliance**
- 4b. or cattails ***Typha latifolia* Seasonally Flooded Herbaceous Alliance**
- 4c. or dominated by low, weak reeds (<2 feet) spike rush ***Eleocharis palustris* Herbaceous Alliance**

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5. **Vancouverian & Rocky Mountain Montane Wet Meadow Group**
 5a. dominated by Baltic rush (also called wire grass) ***Juncus balticus* Herbaceous Vegetation**
 5b. dominated by sedges or other herbaceous species such as Wheat Sedge (*Carex atheroides*),
 Clustered field sedge (*C. praegracilis*), or Northwest territory sedge (also called beaked sedge)
 (*C. utriculata*) ***Carex (atheroides, praegracilis, utriculata)* Montane Wet Meadow Alliance**
6. **Western North American Ruderal Wet Meadow & Marsh Group**
 6a. dominated by Canadian thistle, Prickly lettuce, field penny cress, sow thistle or other weedy
 forbs
 ***Cirsium arvense* - *Lactuca serriolia* - *Thlaspi arvense* Ruderal Mesic-Wet Forb Alliance**
 6b. dominated by quackgrass ... ***Elymus repens* (= *Agropyron repens*) Ruderal Graminoid Alliance**
 6c. Vegetation not like above 7
- 7a. Freshwater or Alkaline Mudflats, vegetation can be very low stature (<1 foot in height) or
 very sparse with barely 10% cover, mostly dominated by forbs 8
 7b. Flat areas that may have once been a wet meadow, or an old mudflat, vegetation is taller (>1
 foot in height), dominated by grasses (low and tall) or forbs 9
8. Alkaline mudflats dominated by salt tolerate non-native plants Oakleaf Goosefoot - Lamb's-
 Quarters - Russian-Thistle (*Chenopodium glaucum*, *Chenopodium alba*, *Salsola kali*)
 **Western North American Ruderal Wet Meadow & Marsh Group**
 ***Chenopodium (glaucum, alba)* - *Salsola kali* Ruderal Salt Flat Forb Alliance**



- 8b. Freshwater mudflats dominated by native species (California Amaranth, Green Amaranth) ...
 **Temperate Pacific Freshwater Wet Mudflat Group**
 ***Amaranthus (californica, powellii)* Sparce Mud Flat Alliance**

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Freshwater Mudflats

9. Area dominated by quackgrass, Canadian thistle, Prickly lettuce, field penny cress, sow thistle or other weedy forbs **Western North American Ruderal Wet Meadow & Marsh Group**
 9a. dominated weedy forbs
 ***Cirsium arvense* - *Lactuca serriolia* - *Thlaspi arvense* Ruderal Mesic-Wet Forb Alliance**
 9b. dominated by quackgrass ... ***Elymus repens* (= *Agropyron repens*) Ruderal Graminoid Alliance**
 9c. Vegetation not like above 10
- 10a. Vegetation dominated by grasses, area low lying, mesic to wet but may remain dry some years, dominated by Alkali Sacaton (*Sporobolus airoides*) or salt grass (*Distichlis spicata*)
 **Intermountain Basins Alkaline-Saline Herb Wet Flat Group**
 *Sporobolus airoides* Herbaceous Alliance
 *Distichlis spicata* Herbaceous Alliance
 10b. Vegetation not like above in all respects 11
11. Vegetation dominated by weedy, non-native forbs, somewhat mesic to dry site
 **Great Basin & Intermountain Ruderal Dry Shrubland & Grassland Group**
 ***Sisymbrium altissimum*-*Descurainia sophia* - *Lappula occidentalis* Ruderal Forb Alliance**
 11b. Vegetation not like above in all respects. If site is a dry-to-mesic site, key as an herbaceous upland type. If site is a mesic to wet site **Undescribed herbaceous wetland type**

Upland Dry, and Dry to Mesic Herbaceous Vegetation

Grasslands must have at least 10% graminoid cover and be large enough to be mapped. The minimum mapping size is 0.5 ha which is equal to 5000 sq m (70 x 70 m), 1.24 acres, or 53,819 sq feet (232 x 232 feet).

- 12a. Upland dry grasslands 13
 12b. Low lying mesic to dry grasslands 14
13. Upland grasslands dominated by native species such as Western Wheatgrass (*Agropyrum smithii* = *Pascopyrum smithii*) or Needle and threadgrass (*Hesperostipa comata* = *Stipa comata*)...
 **Intermountain Semi-Desert Grassland & Steppe Group**
 ***Agropyrum smithii* (= *Pascopyrum smithii*) Grassland Alliance**
 ***Hesperostipa comata* Semi-Desert Grassland Alliance**

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13b. Grasslands surrounded by shrubs or shrub steppe not large enough to be mapped, key as a shrub steppe type page 1

14a. Mesic to dry grasslands in low lying areas, dominated by Alkali-Sacaton or salt grass
 **Intermountain Basins Alkaline-Saline Herb Wet Flat Group**
 ***Sporobolus airoides* Herbaceous Alliance**
 ***Distichlis spicata* Herbaceous Alliance**
 Alkali-Sacaton Grass Salt grass



14b. Vegetation not like above 15

15. Fields and low-lying areas dominated by non-native weeds such as cheat grass, crested wheatgrass or a mixture of non-native forbs such as tall hedge-mustard, Descurania, and stickseed

..... **Great Basin & Intermountain Ruderal Dry Shrubland & Grassland Group**

15a. dominated by cheatgrass..... ***Bromus tectorum* Ruderal Graminoid Alliance**

15b. dominated by crested wheatgrass..... ***Agropyron cristatum* Ruderal Grassland Alliance**

15c. dominated by any number of upland to slightly mesic weedy forbs

..... ***Sisymbrium altissimum*-*Descurainia sophia* - *Lappula occidentalis* Ruderal Forb Alliance**

15d. Vegetation not like above in all respects..... 16.

IV. Sparse

Areas such as in the photographs below may be mapped as a sparsely vegetated map unit. In the field pace out the minimum mapping area and determine the total vascular plant cover. If 10% or greater cover key as shrub or herbaceous type. If less than 10 % then area is considered sparsely vegetated

..... **Intermountain Basins Cliff, Scree & Badland Sparse Vegetati**

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Both of these photo graphs may represent upland grassland types or sparsely vegetated, depending on the total vascular plant canopy cover within a minimum mapping area



Appendix 2: A Conceptual framework for the categorization of the degree of “naturalness” in existing vegetation as interpreted in the NVC, Draft Jan 2012.

The U.S. National Vegetation Classification is a classification of existing vegetation. Many community classifications have focused strictly on “presettlement vegetation,” “potential natural vegetation,” or postulated “climax” or “late-seral” vegetation. Classification of existing vegetation has the advantage that it can be based on direct measurement, analysis, and interpretation.

The classification is also intended to have practical conservation and management applications. For this reason a broad distinction is made between natural/semi-natural vegetation and planted/cultivated vegetation. Furthermore, in order to help set conservation or management priorities, it is also helpful to distinguish those communities that have little or no modification by human activity. i.e. natural/near natural communities, from those with some or extensive modification by humans, i.e. semi-natural/altere d communities. Such a distinction is based on the correlation that conservationists and others make between naturalness and conservation priority. This is not to say that semi-natural communities have no conservation value, e.g., they may serve as important habitat for a particular rare species.

The dynamic nature of vegetation presents some complications in the evaluation of the naturalness and conservation priority of community units. Early and mid seral vegetation may be readily classifiable (as distinct in composition and physiognomy from later seral vegetation), but may be transient on the landscape. Transience makes these early stages difficult to “track” and to evaluate for conservation action (in standard Heritage Program approaches), yet these types manifestly exist, often as a result of natural disturbance processes. The conservation of seral stages will generally require conservation of communities at landscape scales, and the maintenance in those landscapes of the ecological processes responsible for the periodic creation of successional natural communities.

In addition, disturbances cannot be clearly and cleanly classified as “natural” or “anthropogenic.” Some anthropogenic disturbances are similar enough to natural disturbances that the resulting successional communities cannot be clearly distinguished, while others may create novel communities, unprecedented in the natural landscape.

Element ranking (the “element” being a species, plant association, alliance or ecosystem) is one of the standard methodologies for the setting of conservation priorities developed and applied by NatureServe and the Heritage Network. Global, national, and subnational (state or province) element conservation ranks provide basic information on the relative imperilment or risk of extinction of an element within the specified geographic ranges. Element ranks for both species and communities are based on a five point hierarchical scale, ranging from critically imperiled (G1, N1, or S1) to secure (G5, N5, or S5). However, for vegetation communities, the additional issue of the naturalness and successional status of the taxon suggest that it may be helpful to separate the natural/near-natural types from the semi-natural/altere d types for the purposes of ranking. The following categorization of vegetation types and

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associated element ranks is still in the process of development, and is presented here for review and use.

I. NATURAL/SEMI-NATURAL VEGETATION

Ranks G1 through G5, GH, GX, GD, GW, GM

A. Natural/Near-natural Vegetation

Ranks G1 through G5, GH, GX

B. Semi-natural/Altered Vegetation

i. Ruderal Vegetation - rank GD

ii. Modified/Managed Vegetation - rank GM

II. PLANTED/CULTIVATED VEGETATION

Rank GC

PLANTED/CULTIVATED VEGETATION (GC rank)

Planted/cultivated areas are defined as being dominated by vegetation which has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. The majority of these areas are planted and/or maintained for the production of food, feed, fiber, or seed (FGDC 1997).

Conservation practitioners generally have had little interest in classifying, mapping or conserving planted or cultivated vegetation, but other agencies and organizations do. It is important to conceptually separate planted/cultivated vegetation (such as short rotation pine plantations) from natural/semi-natural vegetation (such as successional and natural pine communities), and this is best done by explicitly accounting for these fundamentally different communities in the National Vegetation Classification. Examples of planted/cultivated vegetation include apple orchards, mowed lawns around buildings and facilities, loblolly pine plantations, wheat fields, and cotton fields.

NATURAL/SEMI-NATURAL VEGETATION (G1-G5 [N1-N5, S1-S5], GH [NH, SH], GX [NX, SX], GD, GW, GM ranks)

Natural/semi-natural vegetation is defined broadly to include types which occur spontaneously without regular human management, maintenance, or planting, and which generally have a strong component of native species.

B.1. NATURAL / NEAR-NATURAL VEGETATION (G1-G5 [N1-N5, S1-S5], GH [NH, SH], GX [NX, SX] ranks)

Natural/near-natural vegetation refers to plant communities that appear not to have been modified by human activities, or to have only been marginally impacted by such activities. Where impacts are

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apparent, there exists a clear, naturally maintained analogue for the existing physiognomic *and* floristic patterns. Of these natural/near-natural types, communities that are mid- and late seral are nearly always the highest priority for development and refinement of the classification. These are the communities which NatureServe and Natural Heritage Network consistently classify and track in detail. Examples include oak forests of eastern North America, Ponderosa Pine forests of western North America, Pinyon-juniper woodlands, calcareous glades, spruce forests, coastal marshes, and historic chestnut forests of the Appalachians.

Though early seral communities are “natural” communities they are rarely tracked by Heritage Programs as conservation targets. While the recognition of these communities as “natural” and “real” is conceptually important, they may be difficult or impossible to maintain or preserve through site conservation action. Some of these successional communities result from anthropogenic disturbances that are close cognates of “natural” secondary successional communities, and should also be considered in this category. Examples include fireweed (*Epilobium angustifolium*) communities of boreal and montane areas resulting from fire, willow sandbars of the eastern United States, aspen thickets, and vine thickets resulting from hurricane blowdowns.

B.2. SEMI-NATURAL / ALTERED VEGETATION (GD, GM ranks)

Semi-natural/altered vegetation may be defined as plant communities where the species composition and/or the structure of the vegetation has been altered through anthropogenic disturbance such that no clear natural analogue is known.

RUDERAL COMMUNITIES (GD rank)¹

Ruderal communities are vegetation resulting from succession following anthropogenic disturbance of an area. They are generally characterized by unnatural combinations of native species (such as old/abandoned wood lots in the eastern US) or primarily invasive non-native species, (such as disturbed range lands in the western US). They are spontaneous, self-perpetuating, and not the (immediate) result of planting, cultivation, or human maintenance. Land occupied by invasive communities is generally permanently altered (converted) unless restoration efforts are undertaken. It is also important to recognize that these communities are novel; they are not merely a community “transplanted” from the native range of the dominant species. *Melaleuca* in south Florida, kudzu in the southeastern United States, tamarisk in the western United States, red mangrove in Hawaii, all form communities which have no equivalent in the home range of the dominant species (associated species, processes, landscape context, fauna, etc. are all significantly different). These communities are important to recognize and classify, since their invasive qualities mean that active suppression or control efforts may be needed, in order to avoid the spread of these communities at the expense of natural communities. Examples include tallow-tree forests, tamarisk galleries along western streams, *Phragmites* marshes in non-native range, shrub steppes with alien grasses dominating beneath the shrubs, and mangrove (*Rhizophora*

¹ Ruderal communities here include both native and invasive exotics that occur on anthropogenically disturbed lands, form more-or-less spontaneously, and have no native species analogue based on ecological processes.

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mangle) swamps in Hawaii. These communities are generally not priorities for conservation for their own sake, though they may support rare species or function as important landscape connectors or matrix in reserves. In many landscapes, ruderal communities occupy large areas -- sometimes more than any other category of communities. They can provide important biodiversity functions. In national or state- wide mapping, these ruderal types are important to represent, because of their large extent. Examples of unnatural combinations of native species include tulip tree successional stands following cropping, red-cedar pastures, and "secondary savannas" of the West Indies and other tropical areas with the woody layer often dominated by acacias, mesquite, or palms.

MODIFIED/MANAGED COMMUNITIES (GM rank). Modified/managed communities are vegetation resulting from the management or modification of natural/near natural vegetation, but producing a structural and floristic combination not clearly known to have a natural analogue. Modified vegetation may be easily restorable by either management, time, or restoration of ecological processes. It is not yet clear how to deal with these communities in the National Vegetation Classification. Examples include jack pine barren stands that are managed for sharp-tailed grouse by annual burning (producing a bur oak-northern pin oak scrub grassland), longleaf pine woodlands with canopies converted to slash pine but retaining ground flora characteristic of the longleaf pine woodland, pine forests silviculturally thinned to woodland structures, "unimproved pastures" resulting from removal of trees, and strips of forest between lanes of divided highway (identifiable but "all edge").

Appendix 3: Guide to NVCS Groups of Camas National Wildlife Refuge, with Habitat Characteristics

Sedge species - Reedgrass species Montane Wet Meadow Group

G521–Montane Wet Meadow Group

Sedge species - Reedgrass species Montane Wet Meadow Group

Vancouverian & Rocky Mountain Montane Wet Meadow **Classif. Resp.: West**

Classif. Level: Group **Conf.:** 2 - Moderate **Stakeholders:** Canada, Midwest, West

Status: Standard

Concept Auth.: P. Comer and G. Kittel, in Faber-Langendoen et al. (2011)

Concept Ref.: Faber-Langendoen et al. 2011

ELEMENT CONCEPT

Summary: This group contains the wet meadows found in montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (about 1000-3600 m) from California's Transverse and Peninsular ranges north to British Columbia's coastal mountains and from throughout the Rocky Mountains of Canada and the U.S. (including the Black Hills of South Dakota) and mountain ranges of the intermountain interior west. Wet meadows occur in open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Wet meadows can be tightly associated with snowmelt and typically are not subjected to high velocity disturbance, but can be flooded by slow-moving waters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Vegetation of this group can manifest as a mosaic of several plant associations, or be a monotypic stand of a single association which is dominated by graminoids or forbs. Varying dominant herbaceous species include graminoids *Calamagrostis canadensis*, *Calamagrostis stricta*, *Carex bolanderi*, *Carex exsiccata*, *Carex illota*, *Carex microptera*, *Carex scopulorum*, *Carex utriculata*, *Carex vernacula*, *Deschampsia caespitosa*, *Eleocharis quinqueflora*, *Glyceria striata* (= *Glyceria elata*), *Juncus drummondii*, *Juncus nevadensis*, and *Scirpus* and/or *Schoenoplectus* spp. Forb species include *Camassia quamash*, *Cardamine cordifolia*, *Dodecatheon jeffreyi*, *Phippsia algida*, *Rorippa alpina*, *Senecio triangularis*, *Trifolium parryi*, and *Veratrum californicum*. Common but sparse shrubs may include *Salix* spp., *Vaccinium uliginosum*, *Betula glandulosa*, and *Vaccinium macrocarpon*.

Classification Comments:**Related Concepts:**

- Alpine Grassland (213) (Shiflet 1994) > [SRM type 213 includes all alpine communities in Sierra, Klamath and California Cascades, both herbaceous and shrub-dominated, and wet meadows.]
- Alpine Rangeland (410) (Shiflet 1994) >< [Alpine wet meadows are included in this SRM type.]
- Montane Meadows (216) (Shiflet 1994) >
- Tall Forb (409) (Shiflet 1994) >< [Forb-dominated wet meadows are included in this group.]
- Tufted Hairgrass - Sedge (313) (Shiflet 1994) >< [Wetter portions of this SRM type overlap with this group.]

ELEMENT DESCRIPTION

Environment: *Soil/substrate/hydrology:* Wet meadows are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Wet meadows can be tightly associated with snowmelt and typically are not subjected to high velocity disturbance, but can be flooded by slow-moving waters. Moisture for these wet meadow community types is acquired from groundwater, stream discharge, overland flow, overbank flow, and on-site precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral, or permanent pools may be present. These areas may support species more representative of purely aquatic environments. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface. Fluctuations of the water table throughout the growing season are not uncommon, however. On drier sites supporting the less mesic types, the late-season water table may be 1 m or more below the surface. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Soils may have organic soils inclusions. The presence and amount of organic matter may vary considerably depending on the frequency and magnitude of alluvial deposition (Kittel et al. 1999b). Organic composition of the soil may include a thin layer near the soil surface or accumulations of highly sapric material of up to 120 cm thick. Soils may exhibit gleying and/or mottling throughout the profile. Wet meadows provide important water filtration, flow attenuation, and wildlife habitat functions. Environmental information compiled from Komarkova (1976, 1986), Nachlinger (1985), Kovalchik (1987, 1993), Barbour and Major (1988), Meidinger et al. (1988), Padgett et al. (1988a), Lloyd et al. (1990), Banner et al. (1993), DeLong et al. (1993), Manning and Padgett (1995), Sawyer and Keeler-Wolf (1995), Sanderson and Kettler (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Kittel et al. (1999b), and MacKenzie and Moran (2004).

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Vegetation: Vegetation of this group can manifest as a mosaic of several plant associations, or be a monotypic stand of a single association which is dominated by graminoids or forbs. Varying dominant herbaceous species include graminoids *Calamagrostis canadensis*, *Calamagrostis stricta*, *Carex bolanderi*, *Carex utriculata*, *Carex illota*, *Carex exsiccata*, *Carex nigricans*, *Carex microptera*, *Carex scopulorum*, *Carex vernacula*, *Deschampsia caespitosa*, *Eleocharis quinqueflora*, *Glyceria striata* (= *Glyceria elata*), *Juncus drummondii*, *Juncus nevadensis*, and *Scirpus* and/or *Schoenoplectus* spp. Forb species may include *Camassia quamash*, *Cardamine cordifolia*, *Caltha leptosepala*, *Dodecatheon jeffreyi*, *Phippsia algida*, *Rorippa alpina*, *Senecio triangularis*, *Trifolium parryi*, *Trollius laxus*, and *Veratrum californicum*. Common but sparse shrubs may include *Salix* spp., *Vaccinium uliginosum*, *Betula glandulosa*, and *Vaccinium macrocarpon*. Floristic information compiled from Komarkova (1976, 1986), Nachlinger (1985), Kovalchik (1987, 1993), Barbour and Major (1988), Meidinger et al. (1988), Padgett et al. (1988a), Lloyd et al. (1990), Banner et al. (1993), DeLong et al. (1993), Manning and Padgett (1995), Sawyer and Keeler-Wolf (1995), Sanderson and Kettler (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Kittel et al. (1999b), and MacKenzie and Moran (2004).

Dynamics: This group has soils that may be flooded or saturated throughout the growing season. It may also occur on areas with soils that are only saturated early in the growing season, or intermittently. Typically these associations are tolerant of moderate-intensity ground fires and late-season livestock grazing (Kovalchik 1987). Most appear to be relatively stable types, although in some areas these may be impacted by intensive livestock grazing.

Similar Associations:

- *Caltha leptosepala* - *Carex nigricans* - *Kalmia microphylla* Alpine Wet Meadow & Dwarf-Shrubland Group (G520) is more or less a strictly alpine group that occurs at higher elevations with different dominant species, and is restricted to alpine or upper subalpine environments; however, it may be adjacent to or even overlap with G521 in some areas.
- *Camassia quamash* - *Carex densa* - *Carex unilateralis* Willamette Valley-Puget Trough Wet Meadow & Seep Herbaceous Group (G523) occurs at lower elevations limited to the Willamette Valley.
- *Deschampsia beringensis* - *Argentina egedii* - *Carex obnupta* Vancouverian Freshwater Coastal Marsh & Meadow Group (G517) occurs at lower elevations within 2 miles of coast.
- *Poa pratensis* Ruderal Wet Meadow & Marsh Group (G524)
- *Schoenoplectus* spp. - *Typha* spp. Western North American Temperate Interior Freshwater Marsh Group (G518) occurs at lower elevations.

Similar Association Comments:**Adjacent Associations:**

- *Caltha leptosepala* - *Carex nigricans* - *Kalmia microphylla* Alpine Wet Meadow & Dwarf-Shrubland Group (G520)

Adjacent Association Comments:**Other Comments:**

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Wildlife Habitat: When adjacent to marshes, wet meadows provide a critical component of the habitat for a variety of wetland-associated wildlife species. The vegetation provides an ideal substrate for the invertebrates in the diet of most waterbirds during summer, and seeds produced by meadow plants are important in the fall diets of waterfowl. When wet meadow habitat is flooded, these food resources become available. Many waterbird species forage in flooded wet meadows, including dabbling ducks [e.g. mallard (*Anas platyrhynchos*), gadwall (*A. strepera*) and cinnamon teal (*A. cyanoptera*)], Sandhill crane (*Grus canadensis*), and shorebirds such as Wilson's snipe (*Gallinago delicata*), American avocet (*Recurvirostra americana*), and white-faced ibis (*Plegadis chihi*). The Canada goose (*Branta canadensis*) grazes on meadow vegetation. Short-eared owl (*Asio flammeus*) and northern harrier (*Circus cyaneus*) forage for small mammals in wet meadows. Western meadowlark (*Sturnella neglecta*) and red-winged blackbird (*Agelaius phoeniceus*) commonly feed in wet meadows.

Wet meadows often represent a transition habitat between permanent wetlands and uplands. Wildlife use of wet meadows for breeding varies depending on distance from wetlands and the amount of moisture in a site. Sandhill crane and Wilson's snipe often breed close to permanent water, where meadows are moist. A wide variety of ground-nesting birds use dryer portions of meadows. Dabbling ducks (*Anas* spp.) , including mallard and cinnamon teal, and raptors including short-eared owl, are closely associated with wet meadow, while northern harrier, and songbirds such as savannah sparrow (*Passerculus sandwichensis*) are generally associated, nesting in meadows as well as upland grasslands.

A wide variety of small mammal species are closely associated with meadows for breeding and feeding, including deer mouse (*Peromyscus maniculatus*), meadow vole (*Microtus pennsylvanicus*), montane vole (*M. montanus*), and long-tailed vole (*M. longicaudus*). Herpetofauna closely associated with wet meadow include the common garter snake (*Thamnophis sirtalis*), Columbia spotted frog (*Rana pretiosa luteiventris*), western toad (*Anaxyrus boreas*), and Northern leopard frog (*Lithobates pipiens*).

USFWS Region1 Habitat Types: wet meadow, temporarily-flooded wet meadow, wet prairie, moist meadow

Description Author: P. Comer, mod. G. Kittel and C. Chappell **Version:** 21-Dec-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 9-Dec-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This group occurs in the mountains in California's Transverse and Peninsular ranges north to British Columbia's coastal ranges and is found throughout the Rocky Mountains (including the Black Hills

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of South Dakota) of the U.S. and Canada as well as the intermountain ranges of the interior west, ranging in elevation from montane to alpine (1000-3600 m).

Nations: CA, US

Subnations: AB, AK?, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

TNC Ecoregion	Status Pattern	Distribution	Note
3-North Cascades	C		
4-Modoc Plateau and East Cascades	C		
5-Klamath Mountains	C		
7-Canadian Rocky Mountains	C		
8-Middle Rockies - Blue Mountains	C		
9-Utah-Wyoming Rocky Mountains	C		
11-Great Basin	C		
12-Sierra Nevada	C		
16-California South Coast	C		
18-Utah High Plateaus	C		
19-Colorado Plateau	C		
20-Southern Rocky Mountains	C		
21-Arizona-New Mexico Mountains	C		
22-Apache Highlands	P		
25-Black Hills	C		
68-Okanagan	C		
69-S.E. Alaska - B.C. Coastal Forest and Mountains	C		
81-West Cascades	C		

USFS Ecoregions:

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

References: Banner et al. 1993, Barbour and Major 1988, Cooper 1986b, Crowe and Clausnitzer 1997, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, Faber-Langendoen et al. 2011, Holland and Keil 1995, Johnson and O'Neil 2000, Kittel et al. 1999b, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Lloyd et al. 1990, MacKenzie and Moran 2004, MacKinnon et al. 1990, Manning and Padgett 1995, Meidinger and Pojar 1991, Meidinger et al. 1988, Nachlinger 1985, Padgett et al. 1988a, Reed 1988, Sanderson and Kettler 1996, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Steen and Coupe 1997

Western North American Ruderal Wet Shrubland, Meadow & Marsh

Classif. Level: Group **Conf.:** 2 - Moderate **Stakeholders:** Canada, Midwest, West

Status: Standard

Concept Auth.: D. Faber-Langendoen, in Faber-Langendoen et al. (2011)

Concept Ref.: Faber-Langendoen et al. 2011

ELEMENT CONCEPT

Summary: This group contains disturbed wet meadows found in lowland, montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (sea level to 3600 m) throughout the western U.S. and Canada. These are wet meadows that occur in open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Due to disturbance, soils may be compacted. Vegetation of this group is dominated by non-native species such as *Agrostis gigantea*, *Agrostis stolonifera*, *Conyza canadensis*, *Phalaris arundinacea*, *Phragmites australis*, *Poa palustris*, and *Poa pratensis*. Native species may be present but are so low in abundance that the original native plant association is impossible to determine. These can be wet meadows, wet emergent marshes, coastal backwater dunes, and sloughs.

Classification Comments: This group may be difficult to tease apart from its native counterpart. The test is that the non-native species far outweigh native species in abundance and richness, such that a well-trained observer cannot tell what the native counterpart may have been or to do so is only speculation.

Related Concepts:

ELEMENT DESCRIPTION

Environment: *Soil/substrate/hydrology:* This group occurs in the same environmental settings as ~Vancouverian & Rocky Mountain Montane Wet Meadow Group (G521)\$\$, ~Vancouverian Freshwater Coastal Marsh & Meadow Group (G517)\$\$, and ~Western North American Temperate Interior Freshwater Marsh Group (G518)\$\$.

Vegetation: Vegetation of this group is dominated by non-native species such as *Agrostis gigantea*, *Agrostis stolonifera*, *Conyza canadensis*, *Phalaris arundinacea*, *Phragmites australis*, *Poa palustris*, and *Poa pratensis*. Native species may be present but are so low in abundance that the original native plant

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association is impossible to determine. Floristic information was compiled from Whitson et al. (1996), Rondeau (2001), Faber-Langendoen et al. (2008), and Sawyer et al. (2009).

Dynamics: This group is a product of disturbance such as continuous heavy grazing by domestic livestock, soil disturbance/compactions, and noxious weed infestation.

Similar Associations:

- *Carex* spp. - *Calamagrostis* spp. Montane Wet Meadow Group (G521) is dominated by native species.
- *Deschampsia beringensis* - *Argentina egedii* - *Carex obnupta* Vancouverian Freshwater Coastal Marsh & Meadow Group (G517) is dominated by native species.
- *Schoenoplectus* spp. - *Typha* spp. Western North American Temperate Interior Freshwater Marsh Group (G518) is dominated by native species.

Similar Association Comments:

Adjacent Associations:

Adjacent Association Comments:

Other Comments:

Wildlife Habitat: Overall, wildlife species that use the Introduced Mesic-Wet Herbaceous Species Group are similar to those that use Montane Wet Meadow. However, the reduced plant diversity of these weedy sites generally leads to lowered wildlife diversity as well. Diversity of wildlife is roughly correlated with diversity of the plant community and size of the patch, with dense, single species weed stands supporting generally very low diversity of wildlife. See Montane Wet Meadow Group for wildlife relationships.

USFWS Region 1 Habitat Types:

Description Author: G. Kittel **Version:** 21-Dec-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 9-Dec-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This group is found throughout the entire western U.S. and Canada.

Nations: CA, US

Subnations: AB, AK, BC, CA, CO, ID, MT, NM, NV, OR, SD, WA, WY

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TNC Ecoregion	Status Pattern	Distribution	Note
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USFS Ecoregions:

Federal Lands:

ELEMENT SOURCES

References: Faber-Langendoen et al. 2008, Faber-Langendoen et al. 2011, Johnson and O'Neil 2000, Rondeau 2001, Sawyer et al. 2009, Whitson et al. 2000

Temperate Pacific Freshwater Wet Mudflat

G525—FRESHWATER MUFLAT GROUP

Temperate Pacific Freshwater Wet Mudflat **Classif. Resp.: West**

Classif. Level: Group **Conf.:** 2 - Moderate **Stakeholders:** West

Status: Standard

Concept Auth.: C. Chappell, in Faber-Langendoen et al. (2011)

Concept Ref.: Faber-Langendoen et al. 2011

ELEMENT CONCEPT

Summary: This group consists of associations that occur on freshwater mudflats that are found scattered throughout the temperate regions of the Pacific Coast of North America. In the Pacific Northwest, they occur primarily in seasonally flooded shallow lakebeds and on floodplains, especially along the lower Columbia River. During any one year, they may be absent because of year-to-year variation in river water levels. Mudflats must be exposed before the vegetation develops from the seedbank. They are dominated mainly by low-statured annual plants. They range in physiognomy from sparsely vegetated mud to extensive sods of herbaceous vegetation. The predominant species include *Eleocharis obtusa*, *Lilaeopsis occidentalis*, *Crassula aquatica*, *Limosella aquatica*, *Gnaphalium palustre*, *Eragrostis hypnoides*, and *Ludwigia palustris*.

Classification Comments:

Related Concepts:

ELEMENT DESCRIPTION

Environment: *Climate:* Temperate. *Soil/substrate/hydrology:* Seasonally flooded shallow lakebeds and on floodplains.

Vegetation: The predominant species include *Eleocharis obtusa*, *Lilaeopsis occidentalis*, *Crassula aquatica*, *Limosella aquatica*, *Gnaphalium palustre*, *Eragrostis hypnoides*, and *Ludwigia palustris*.

Dynamics: May be absent because of year-to-year variation in river water levels. Mudflats must be exposed before the vegetation develops from the seedbank.

Similar Associations:

- *Vaucheria longicaulis* - *Enteromorpha* spp. North American Intertidal Algal Flat Group (G385)

Similar Association Comments:

Adjacent Associations:

Adjacent Association Comments:

Other Comments:

Wildlife Habitat: Often in juxtaposition with wet meadows or marshes, mudflats are used by a variety of wetland bird species. Killdeer (*Charadrius vociferus*), American avocet (*Recurvirostra americana*), and black-necked stilt (*Himantopus mexicanus*) will nest on mudflats that are dry. The broods of these species forage in shallowly-flooded mudflats and adjacent habitat. When shallowly flooded, mudflats become important foraging habitat for most shorebirds, and many depend on mudflats during their protracted summer migration, July through September. Species include killdeer (*Charadrius vociferous*), western sandpiper (*Calidris mauri*), and long-billed dowitcher (*Limnodromus scolopaceus*). Use by birds depends on water depth and timing of mudflat exposure.

USFWS Region 1 Habitat Types:

Description Author: C. Chappell and G. Kittel **Version:** 20-Dec-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 15-Oct-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This group is found throughout the temperate regions of the Pacific Coast of North America.

Nations: US

Subnations: AK, CA, OR, WA

TNC Ecoregion	Status Pattern	Distribution	Note
2-Puget Trough - Willamette Valley - Georgia Basin	C		
14-California North Coast	C		
15-California Central Coast	C		
16-California South Coast	C		

USFS Ecoregions:**Federal Lands:****ELEMENT SOURCES**

References: Chappell and Christy 2004, Faber-Langendoen et al. 2011, Holland and Keil 1995, Johnson and O'Neil

Western North American Temperate Interior Freshwater Marsh

G518—FRESHWATER MARSH GROUP

Bullrush and Cattail Species Freshwater Marsh Group

Western North American Temperate Interior Freshwater Marsh

Classif. Level: Group **Conf.:** 1 - Strong **Stakeholders:** Canada, West

Status: Standard

Concept Auth.: C. Chappell, R. Crawford, K.A. Schulz in D. Faber-Langendoen et al. (2010)

Concept Ref.: Faber-Langendoen et al. 2011

ELEMENT CONCEPT

Summary: Freshwater marshes are found at all elevations below timberline throughout the temperate Pacific Coast, temperate western interior and coastal mountains of western North America. This group includes shallow freshwater water bodies found in small depressions gouged into basalt by Pleistocene floods, channeled scablands of the Columbia Plateau and within dune fields in the intermountain western U.S. These wetlands are mostly small-patch, confined to limited areas in suitable floodplain or basin topography. They are mostly semipermanently flooded, but some marshes have seasonal hydrologic flooding. Water is at or above the surface for most of the growing season. A consistent source of freshwater is essential to the function of these systems. Soils are muck or mineral or muck over a mineral soil, and water is high-nutrient. Occurrences of this group typically are found in a mosaic with other wetland systems. It is often found along the borders of ponds, lakes or reservoirs that have more open basins and a permanent water source throughout all or most of the year. Some of the specific communities will also be found in floodplain systems where more extensive bottomlands remain. They may occur at the bottom of a basalt cliff in a lined circular or linear depression, or occur as small (usually less than 0.1 ha) interdunal wetlands in wind deflation areas, where sands are scoured down to the water table. The water table may be perched over an impermeable layer of caliche or clay or, in the case of the Great Sand Dunes of Colorado, a geologic dike that creates a closed basin that traps water.

By definition, freshwater marshes are dominated by emergent herbaceous species, mostly graminoids (*Carex*, *Scirpus* and/or *Schoenoplectus*, *Eleocharis*, *Juncus*, *Typha latifolia*) but also some forbs. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Eleocharis*, *Sparganium*, *Sagittaria*, *Bidens*, *Cicuta*, *Rorippa*, *Mimulus*, and *Phalaris*. Maritime Alaska freshwater marshes are described as having *Carex rostrata*, *Equisetum fluviatile* (often pure stands), *Carex aquatilis* var. *dives* (= *Carex sitchensis*), *Menyanthes trifoliata*, *Comarum palustre*, *Eleocharis palustris*, and *Schoenoplectus tabernaemontani*. In relatively deep water, there may be floating-leaved genera such as *Lemna*, *Potamogeton*, *Polygonum*, *Nuphar*, *Hydrocotyle*, and *Brasenia*. Woody plants, including *Populus tremuloides*, *Salix exigua*, *Crataegus douglasii*, or *Rosa woodsii*, may present adjacent to northerly

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wetland marshes. Ponds may be adjacent to *Artemisia* shrub-steppe and *Pinus ponderosa* savanna or woodland.

Classification Comments:

Related Concepts:

- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) >
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) >
- Wetlands (217) (Shiflet 1994) >

ELEMENT DESCRIPTION

Environment: *Climate:* Temperate Continental climate. *Soil/substrate/hydrology:* They are mostly semipermanently flooded, but some marshes have seasonal hydrologic flooding. Water is at or above the surface for most of the growing season. A consistent source of freshwater is essential to the function of these systems. Soils are muck or mineral or muck over a mineral soil, and water is high-nutrient. Environmental information compiled from Bowers (1982, 1984, 1986), Banner and Trowbridge (1986), Lloyd et al. (1990), MacKinnon et al. (1990), Cooper and Severn (1992), Viereck et al. (1992), Banner et al. (1993), Shiflet (1994), Holland and Keil (1995), Shephard (1995), Steen and Coupe (1997), Hammond (1998), Pineada et al. (1999), Boggs (2000), Pineda (2000), Rondeau (2001), Brand and Sanderson (2002), and Chappell and Christy (2004).

Vegetation: A variety of emergent herbaceous vegetation may occur, including *Schoenoplectus* spp., *Typha* spp., *Cyperus* spp., *Eleocharis* spp., and *Salix exigua*. By definition, freshwater marshes are dominated by emergent herbaceous species, mostly graminoids (*Carex*, *Scirpus* and/or *Schoenoplectus*, *Eleocharis*, *Juncus*, *Typha latifolia*) but also some forbs. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Eleocharis*, *Sparganium*, *Sagittaria*, *Bidens*, *Cicuta*, *Rorippa*, *Mimulus*, and *Phalaris*. Maritime Alaska freshwater marshes are described as having *Carex rostrata*, *Equisetum fluviatile* (often pure stands), *Carex aquatilis* var. *dives* (= *Carex sitchensis*), *Menyanthes trifoliata*, *Comarum palustre*, *Eleocharis palustris*, and *Schoenoplectus tabernaemontani*. In relatively deep water, there may be floating-leaved genera such as *Lemna*, *Potamogeton*, *Polygonum*, *Nuphar*, *Hydrocotyle*, and *Brasenia*. Woody plants, including *Populus tremuloides*, *Salix exigua*, *Crataegus douglasii*, or *Rosa woodsii*, may present adjacent to northerly wetland marshes. Ponds may be adjacent to *Artemisia* shrub-steppe and *Pinus ponderosa* savanna or woodland. Floristic information compiled from Bowers (1982, 1984, 1986), Banner and Trowbridge (1986), Lloyd et al. (1990), MacKinnon et al. (1990), Cooper and Severn (1992), Viereck et al. (1992), Banner et al. (1993), Shiflet (1994), Holland and Keil (1995), Shephard (1995), Steen and Coupe (1997), Hammond (1998), Pineada et al. (1999), Boggs (2000), Pineda (2000), Rondeau (2001), Brand and Sanderson (2002), and Chappell and Christy (2004).

Dynamics: Isolated marshes in dune systems are subject to changes in size and location of the wet swales as the sand dunes shift, due to active dune migration. Dune "blowouts" and subsequent stabilization through succession are characteristic processes of the active dunes which surround the interdunal swales.

Similar Associations:

- *Carex* spp. - *Calamagrostis* spp. Montane Wet Meadow Group (G521)
- *Poa pratensis* Ruderal Wet Meadow & Marsh Group (G524)

Similar Association Comments:**Adjacent Associations:****Adjacent Association Comments:****Other Comments:**

Wildlife Habitat: Emergent marshes are often found in close proximity to open water and wet meadow habitats. The ratio of open water to emergent vegetation in a wetland is related to how productive the wetland is for wildlife.

Bird species that nest in emergent vegetation include eared grebe (*Podiceps nigricollis*), pied-billed grebe (*Podilymbus podiceps*), Virginia rail (*Rallus rallus*), sora (*Porzana carolina*), redhead (*Aythya americana*), marsh wren (*Cistothorus palustris*) and yellow-headed blackbird (*Xanthocephalus xanthoceph*). Water depth is an important factor where individual species nest and feed. The muskrat (*Ondatra zibethicus*) is a common breeding mammal in marshes, constructing lodges and platforms from the emergent vegetation.

A wide variety of wildlife species feed in marshes as well. After nesting in meadows or uplands, dabbling ducks (e.g., mallard (*Anas platyrhynchos*), cinnamon teal (*A. cyanoptera*), gadwall (*A. strepera*)) bring their broods to marshes where the duckling use emergent vegetation for hiding cover and forage for insects and plant seeds in the emergent vegetation and open water. Diving ducks (e.g., *Aythya* sp.) and Wilson's snipe (*Gallinago delicate*) forage in marshes as well. Rails and muskrat forage in the emergent vegetation. American white pelican (*Pelecanus erythrorhynchos*) catch fish in the open water of large wetlands, and moose (*Alces alces*) graze on marsh vegetation.

USFWS Region 1 Habitat Types: Hemi-Marsh, open water – submerged aquatic, permanent wetlands – open water with aquatic beds, emergent marsh, deep marsh, semi-permanent wetlands – persistent emergent vegetation, shallow marsh, shallow emergent marsh, shallow ephemeral marsh, seasonal wetlands, seasonally-flooded marsh

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ELEMENT GLOBAL RANK & REASONS**GRank:** GNR **GRank Review Date:** 8-Dec-2010**GReasons:****Ranking Author:** **Version:****ELEMENT DISTRIBUTION**

Range: This group is found throughout the temperate Pacific Coast, temperate western North America interior (Columbia Basin, Great Basin, Colorado Plateau; coastal mountains of western North America, from southern coastal California north into coastal areas of British Columbia and Alaska. It is also known to occur in dune fields across the intermountain western U.S., including the Great Sand Dunes in southern Colorado and the Pink Coral Dunes in Utah, and may also occur in dune fields in northeastern Arizona and the Great Basin, as well as in southwestern Wyoming in the Killpecker Dunes and Ferris Dunes, and southern Idaho.

Nations: CA, US**Subnations:** AK, AZ?, BC, CA, CO, ID, NV, OR, UT, WA, WY

TNC Ecoregion	Status Pattern	Distribution	Note
1-Pacific Northwest Coast	C		
2-Puget Trough - Willamette Valley - Georgia Basin	C		
3-North Cascades	C		
4-Modoc Plateau and East Cascades	C		
6-Columbia Plateau	C		
10-Wyoming Basins	C		
11-Great Basin	C		
12-Sierra Nevada	C		
13-Great Central Valley	C		
14-California North Coast	C		
15-California Central Coast	C		
16-California South Coast	C		
19-Colorado Plateau	C		
20-Southern Rocky Mountains	C		
68-Okanagan	P		
69-S.E. Alaska - B.C. Coastal Forest and Mountains	C		
70-Gulf of Alaska Mountains and Fjordlands	C		
81-West Cascades	C		

USFS Ecoregions:**Federal Lands:****ELEMENT SOURCES**

References: Banner et al. 1986, Banner et al. 1993, Boggs 2000, Bowers 1982, Bowers 1984, Bowers 1986, Brand and Sanderson 2002, Chappell and Christy 2004, Comer et al. 2003, Cooper and Severn 1992, Faber-Langendoen et al. 2011, Hammond 1998, Holland and Keil 1995, Johnson and O'Neil 2000,

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Lloyd et al. 1990, MacKinnon et al. 1990, Pineada et al. 1999, Pineda 2000, Rondeau 2001, Shephard 1995, Shiflet 1994, Steen and Coupe 1997, Viereck et al. 1992

Rocky Mountain & Great Basin Lowland & Foothill Riparian & Seep Shrubland

G526—WOODY RIPARIAN GROUP

Coyote Willow - Hawthorn species - Stretchberry Riparian Shrubland Group

Rocky Mountain & Great Basin Lowland & Foothill Riparian & Seep Shrubland

Classif. Level: Group **Conf.:** 1 - Strong **Stakeholders:** Canada, Midwest, West

Status: Standard

Concept Auth.: G. Kittel, in Faber-Langendoen et al. (2011)

Concept Ref.: Faber-Langendoen et al. 2011

ELEMENT CONCEPT

Summary: This group occurs throughout the Rocky Mountain and Colorado Plateau regions from approximately 900 to 1850 m (3000-6000 feet) in elevation, around the edges and between the mountain ranges of the Great Basin and along the lower eastern slope of the Sierra Nevada at about 1220 m (4000 feet) in elevation, at lowland and montane elevations in the Columbia Plateau, on the periphery of the mountains surrounding the Columbia River Basin, and along major tributaries and the main stem of the Columbia at relatively low elevations. It also occurs in the foothills of the northern Rocky Mountains and the east slopes of the Cascades in the lower montane and foothill zones. Climate is generally semi-arid. These shrublands occur along all streams at and below lower treeline, that is, not up in the mountains, but in the between-mountain valleys and lowlands of the interior west. Streams are permanent, intermittent and ephemeral. Stands occur in steep-sided canyons or in broad flat valleys. They can be large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. They also are typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches, and they can occur in depressional wetlands and non-alkaline playas. These shrublands require flooding and bare gravels for reestablishment. Stands are maintained by annual flooding and hydric soils throughout the growing season. Sites are subject to temporary flooding during spring runoff. The water table is often just below the ground surface. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks and benches.

Medium height to short shrubs characterize this group. Very tall (>3 m) shrubs such as *Alnus* and *Betula* belong to ~Rocky Mountain & Great Basin Montane Alder & Birch Riparian Shrubland Group (G504)\$. Dominant shrubs include *Acer glabrum*, *Artemisia cana*, *Artemisia cana ssp. bolanderi*, *Artemisia cana ssp. viscidula*, *Artemisia tridentata ssp. tridentata*, *Cornus sericea*, *Crataegus douglasii*, *Crataegus rivularis*, *Dasiphora fruticosa ssp. floribunda*, *Forestiera pubescens*, *Oplopanax horridus*, *Philadelphus lewisii*, *Prunus virginiana*, *Rhus trilobata*, *Rosa nutkana*, *Rosa woodsii*, *Salix exigua*, *Salix irrorata*, *Salix melanopsis*, *Shepherdia argentea*, and *Symphoricarpos* spp. Herbaceous layers are often dominated by

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Athyrium filix-femina, *Carex flava* (= *Carex nevadensis*), *Carex* spp., *Elymus trachycaulus*, *Equisetum arvense*, *Deschampsia caespitosa*, *Festuca idahoensis*, *Galium triflorum*, *Glyceria striata*, *Gymnocarpium dryopteris*, *Heracleum maximum*, *Iris missouriensis*, *Juncus balticus*, *Juncus* spp., *Leymus cinereus*, *Maianthemum stellatum*, *Muhlenbergia filiformis*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, *Poa cusickii*, and *Poa secunda* (= *Poa nevadensis*). Introduced forage species such as *Agrostis stolonifera*, *Poa pratensis*, *Phleum pratense*, and the invasive annual *Bromus tectorum* are often present in disturbed stands.

Classification Comments: This group represents medium and short-height shrubs. Very tall (>3 m) shrubs such as *Alnus* and *Betula* belong to ~Rocky Mountain & Great Basin Montane Alder & Birch Riparian Shrubland Group (G504)\$. This group also represents lower elevation and foothill elevations shrublands. Higher elevation shrublands belong to ~Rocky Mountain & Great Basin Montane Riparian & Seep Shrubland Group (G527)\$\$.

Related Concepts:

- Other Sagebrush Types (408) (Shiflet 1994) >> [*Artemisia cana* ssp. *viscidula* shrublands are included.]
- Riparian (422) (Shiflet 1994) >

ELEMENT DESCRIPTION

Environment: *Climate:* Climate is generally semi-arid continental with typically cold winters and hot summers. *Soil/substrate/hydrology:* These shrublands occur along all streams at and below lower treeline, that is, not up in the mountains, but in the between- mountain valleys and lowlands of the interior west. Streams are permanent, intermittent and ephemeral. Stands occur in steep-sided canyons or in broad flat valleys. They can be large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. They also are typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches, and they can occur in depressional wetlands and non-alkaline playas, on hillside seeps and springs. These shrublands require flooding and bare gravels for reestablishment. Stands are maintained by annual flooding and hydric soils throughout the growing season. Sites are subject to temporary flooding during spring runoff. The water table is often just below the ground surface. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Soils are fine-textured with organic material over coarser alluvium. Some soils are more developed due to a slightly more stable environment and greater input of organic matter. Environmental information was compiled from the following sources: Daubenmire (1952), Johnson and Simon (1985), Kovalchik (1987, 1992), Hansen et al. (1989), Manning and Padgett (1989, 1995), Padgett et al. (1989), Szaro (1989), MacKinnon et al. (1990), Banner et al. (1993), Delong et al. (1993), Sawyer and Keeler-Wolf (1995), Walford (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Walford et al. (1997, 2001), Kittel et al. (1999b), Muldavin et al. (2000a), Delong (2003), MacKenzie and Moran (2004), and Sawyer et al. (2009).

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Vegetation: Dominant shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia cana* ssp. *bolanderi*, *Artemisia cana* ssp. *viscidula*, *Artemisia cana*, *Artemisia tridentata* ssp. *tridentata*, *Cornus sericea*, *Crataegus douglasii*, *Crataegus rivularis*, *Dasiphora fruticosa* ssp. *floribunda*, *Forestiera pubescens*, *Oplopanax horridus*, *Philadelphus lewisii*, *Prunus virginiana*, *Rhus trilobata*, *Rosa nutkana*, *Rosa woodsii*, *Salix exigua*, *Salix irrorata*, *Salix melanopsis*, *Shepherdia argentea*, and *Symphoricarpos* spp. Herbaceous layers are often dominated by *Athyrium filix-femina*, *Carex flava* (= *Carex nevadensis*), *Carex* spp., *Elymus trachycaulus*, *Equisetum arvense*, *Deschampsia caespitosa*, *Festuca idahoensis*, *Galium triflorum*, *Glyceria striata*, *Gymnocarpium dryopteris*, *Heracleum maximum*, *Iris missouriensis*, *Juncus balticus*, *Juncus* spp., *Leymus cinereus*, *Maianthemum stellatum*, *Muhlenbergia filiformis*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, *Poa cusickii*, and *Poa secunda* (= *Poa nevadensis*). Introduced forage species such as *Agrostis stolonifera*, *Poa pratensis*, *Phleum pratense*, and the invasive annual *Bromus tectorum* are often present in disturbed stands. Floristic information was compiled from the following sources: Daubenmire (1952), Johnson and Simon (1985), Kovalchik (1987, 1992), Hansen et al. (1989), Manning and Padgett (1989, 1995), Padgett et al. (1989), Szaro (1989), MacKinnon et al. (1990), Banner et al. (1993), Delong et al. (1993), Sawyer and Keeler-Wolf (1995), Walford (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Walford et al. (1997, 2001), Kittel et al. (1999b), Muldavin et al. (2000a), Delong (2003), MacKenzie and Moran (2004), and Sawyer et al. (2009).

Dynamics: These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Livestock grazing is a major influence in altering structure, composition, and function of the community (Baker 1988, 1989a, Padgett et al. 1989).

Similar Associations:

- *Adiantum* spp. - *Mimulus* spp. - *Aquilegia* spp. Colorado Plateau Hanging Garden Group (G545)
- *Alnus incana* - *Betula occidentalis* Riparian/Seep Shrubland Group (G504) includes tall riparian shrublands dominated by *Alnus* or *Betula* species only.
- *Alnus* spp. - *Salix* spp. - *Spiraea* spp. Lowland Riparian & Wet Slope Shrubland Group (G322)
- *Cornus* spp. - *Prunus virginiana* / *Pascopyrum smithii* Great Plains Shrub & Herb Riparian Group (G337)
- *Salix interior* - *Salix* spp. Great Plains Riverine Scour Group (G568)
- *Salix* spp. Riparian & Seep Shrubland Group (G527) includes riparian shrublands that occur at high elevations and are dominated by more montane species, for example *Salix monticola*.

Similar Association Comments:**Adjacent Associations:****Adjacent Association Comments:****Other Comments:**

Wildlife Habitat: These woody riparian habitats support a wide variety of songbird species, including yellow warbler (*Dendroica petechia*), willow flycatcher (*Empidonax traillii*), lazuli bunting (*Passerina amoena*), warbling vireo (*Vireo gilvus*), fox sparrow (*Passerella iliaca*) and Bullock's oriole (*Icterus*

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bullockii) for both feeding and breeding. Belted kingfisher (*Megaceryle alcyon*) and great-blue heron (*Ardea herodias*) are closely associated for breeding and feeding as well. Closely associated mammal species include mink (*Neovision vison*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and water shrew (*Sorex palustris*). The moose (*Alces alces*) is generally associated and commonly browses on willow. Woody riparian habitat is known for shading stream courses and lowering water temperatures, providing better trout habitat than streams lacking shade. Closely associated amphibians include tiger salamander (*Ambystoma tigrinum*), long-toed salamander (*Ambystoma macrodactylum*), Great Basin spadefoot (*Spea intermontana*), pacific chorus frog (*Pseudacris regilla*), and Columbia spotted frog (*Rana pretiosa luteiventris*). The common garter snake (*Thamnophis sirtalis*) is closely associated with riparian areas as well.

USFWS Region 1 Habitat Types: riparian, alluvial riparian woodland, riparian scrub-shrub, woody riparian, riverine wetlands, willow woodland, aspen/deciduous shrub riparian forests, shrub-dominated riparian

Description Author: G. Kittel **Version:** 20-Dec-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 9-Dec-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This group is found throughout the Rocky Mountain and Colorado Plateau regions from approximately 900 to 1850 m (3000-6000 feet) in elevation, in the mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada from about 1220 m (4000 feet) in elevation, at lowland and montane elevations in the Columbia Plateau, on the periphery of the mountains surrounding the Columbia River Basin, and along major tributaries and the main stem of the Columbia at relatively low elevations. It also occurs in the northern Rocky Mountains and the east slopes of the Cascades in the lower montane and foothill zones.

Nations: CA, US

Subnations: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

TNC Ecoregion	Status Pattern	Distribution	Note
6-Columbia Plateau	C		
7-Canadian Rocky Mountains	C		

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8-Middle Rockies - Blue Mountains	C
9-Utah-Wyoming Rocky Mountains	C
11-Great Basin	C
12-Sierra Nevada	C
18-Utah High Plateaus	C
19-Colorado Plateau	C
20-Southern Rocky Mountains	C
25-Black Hills	C
26-Northern Great Plains Steppe	C
68-Okanagan	C

USFS Ecoregions:**Federal Lands:****ELEMENT SOURCES**

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Banner et al. 1993, Barbour and Billings 1988, Carsey et al. 2003a, Crowe and Clausnitzer 1997, Daubenmire 1952, DeLong 2003, DeLong et al. 1993, Eyre 1980, Faber-Langendoen et al. 2011, Hansen et al. 1988b, Hansen et al. 1989, Johnson and O'Neil 2000, Johnson and Simon 1985, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, MacKenzie and Moran 2004, MacKinnon et al. 1990, Manning and Padgett 1989, Manning and Padgett 1995, Maser et al. 1984, Muldavin et al. 2000a, Padgett et al. 1989, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Steen and Coupe 1997, Szaro 1989, Walford 1996, Walford et al. 1997, Walford et al. 2001

Intermountain Basins Alkaline-Saline Herb Wet Flat Group

G538—ALKALINE-SALINE WET MEADOW GROUP

Inland Saltgrass - Lemmon's Alkali Grass - Saltwort species Alkaline-Saline Herb Wet Flat Group

Intermountain Basins Alkaline-Saline Herb Wet Flat Group

Note: *This group was NOT mapped at Camas NWR.*

Classif. Resp.: West

Classif. Level: Group **Conf.:** 1 - Strong **Stakeholders:** West

Status: Standard

Concept Auth.: G. Kittel, in Faber-Langendoen et al. (2011)

Concept Ref.: Faber-Langendoen et al. 2011

ELEMENT CONCEPT

Summary: This group is found in the intermountain western U.S. Associations are composed of barren and sparsely vegetated playas (generally <10% plant cover). Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. The flats are intermittently, seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. Water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. During exceptionally wet years, increased precipitation can dilute soil salt concentrations which may allow less salt-tolerant species to become established or more abundant. Some stands occur on floodplains, along the margins of perennial lakes, and in alkaline closed basins, with extremely low-gradient shorelines. Characteristic species may include *Allenrolfea occidentalis*, *Atriplex* spp., *Distichlis spicata*, *Grayia spinosa*, *Leymus cinereus*, *Leymus triticoides* (= *Elymus triticoides*), *Muhlenbergia* spp., *Poa secunda*, *Puccinellia lemmonii*, *Salicornia* spp., *Sarcobatus vermiculatus*, *Schoenoplectus americanus*, *Schoenoplectus maritimus*, and *Triglochin maritima*.

Classification Comments:

Related Concepts:

ELEMENT DESCRIPTION

Environment: *Climate:* Cold desert. *Soil/substrate/hydrology:* This group is found on barren and sparsely vegetated playas (generally <10% plant cover). Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. The flats are intermittently, seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. Water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. During exceptionally wet years, increased precipitation can dilute

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soil salt concentrations which may allow less salt-tolerant species to become established or more abundant. Some stands occur on floodplains, along the margins of perennial lakes, and in alkaline closed basins, with extremely low-gradient shorelines. Environmental information compiled from individual associations and Knight (1994).

Vegetation: Characteristic species may include *Allenrolfea occidentalis*, *Atriplex* spp., *Distichlis spicata*, *Grayia spinosa*, *Leymus cinereus*, *Leymus triticoides* (= *Elymus triticoides*), *Muhlenbergia* spp., *Poa secunda*, *Puccinellia lemmonii*, *Salicornia* spp., *Sarcobatus vermiculatus*, *Schoenoplectus americanus*, *Schoenoplectus maritimus*, and *Triglochin maritima*.

Dynamics: Playas are shallow, seasonal wetlands that lie in the lowest point of a closed watershed. Their basins are lined with clay soils, which collect and hold water from rainfall and runoff events. Water evaporates, leaving high salt concentrations in the soils. Some playas will only flood with water during years with high precipitation, sometimes only once or twice in a decade. Others will have standing water every spring, except in the driest of years. During flooded years, some salt-tolerant marsh plant species may grow, such as cattails (*Typha* spp.) or bulrush (*Scirpus* and/or *Schoenoplectus* spp.) (Knight 1994).

Similar Associations:

- *Allenrolfea occidentalis* - *Suaeda moquinii* - *Salicornia rubra* Alkaline Herb Marsh & Seep Vegetation Group (G540) occurs in warm desert climes and is dominated by herbaceous species.
- *Allenrolfea occidentalis* - *Suaeda* spp. - *Distichlis spicata* Scrub & Herb Playa & Wet Flat Herbaceous Vegetation Group (G539) occurs in warmer desert climes and is dominated by cold-intolerant shrubs.
- *Distichlis spicata* - *Hordeum jubatum* - *Pascopyrum smithii* Great Plains Brackish Marsh Group (G324) also includes salt-tolerant herbaceous wetlands, but occurs east of the Continental Divide on the Great Plains.
- *Sarcobatus vermiculatus* - *Atriplex* spp. Intermountain Basins Alkaline-Saline Shrub Wetland Group (G537) also occurs in cold desert regions but is dominated by shrub species.

Similar Association Comments:

Adjacent Associations:

Adjacent Association Comments:

Other Comments:

Wildlife Habitat: In general, many of the same wildlife species that use Montane Wet Meadow use the Alkaline-saline Wet Meadow Group as well. Overall, species diversity may be less in alkaline meadows compared to montane meadow. Several amphibian species are generally associated for foraging, including western toad (*Anaxyrus boreas*) and Pacific chorus frog (*Pseudacris regilla*). Great Basin spadefoot (*Spea intermontana*) breeds and forages in the plant community.

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Closely associated avian species that breed and forage include black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americana*), and willet (*Catoptrophorus semipalmata*). A wide variety of migrating shorebirds forage in the plant community, including sandpipers (*Calidris* spp.), and dowitchers (*Limnodromus* spp.).

USFWS Region 1 Habitat Types: seasonal alkali wetlands

Description Author: G. Kittel **Version:** 17-Dec-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 15-Oct-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This group is found throughout the intermountain western U.S.

Nations: US

Subnations: CA, CO, ID, NM, NV, OR, UT, WA?, WY

TNC Ecoregion	Status Pattern	Distribution	Note
6-Columbia Plateau	C		
10-Wyoming Basins	C		
11-Great Basin	C		
19-Colorado Plateau	C		

USFS Ecoregions:

Federal Lands:

ELEMENT SOURCES

References: Faber-Langendoen et al. 2011, Knight 1994, Shiflet 1994

Intermountain Semi-Desert Shrubland & Steppe Group

G310–NON-SAGE SHRUBLAND SHRUBLAND GROUP

Yellow Rabbitbrush - Rubber Rabbitbrush - Winterfat Shrubland Group

Intermountain Semi-Desert Shrubland & Steppe Group

Classif. Level: Group **Conf.:** 3 - Weak **Stakeholders:** West

Status: Standard

Concept Auth.: N.E. West (1983e)

Concept Ref.: West 1983e

ELEMENT CONCEPT

Summary: This group occurs throughout the Colorado Plateau, Arizona - New Mexico Mountains, west to the Mojave Desert and north to the Wyoming Basin on alluvial flats and fans, talus slopes, plateaus, and bluffs. Slopes range from gentle to steep, and substrates are variable and include sandstone talus, fine-textured alluvium, sand, clay, loams, cinder, cobbles, and coarse gravels. This semi-arid steppe can either be shrub-, dwarf-shrub-, or grass-dominated with a sparse shrub layer. Common shrubs include *Atriplex canescens*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Ephedra viridis*, *Ephedra torreyana*, *Krascheninnikovia lanata*, *Chrysothamnus viscidiflorus*, *Tetradymia canescens*, and *Gutierrezia sarothrae*. Herbaceous species include *Pleuraphis jamesii*, *Bromus tectorum*, *Achnatherum hymenoides*, *Aristida purpurea*, and *Hesperostipa comata*. Disturbance and grazing have impacted many occurrences, and in some cases may be important in maintaining these communities.

Classification Comments: This group is somewhat a catch-all for semi-desert shrublands in the Intermountain West. Many of these communities are somewhat disturbance-maintained, early-seral types. It needs review and discussion to clarify the associations that should be placed here. Shrub communities occurring over talus included in this group are part of a continuum and can be highly variable, and some dwarf-shrub communities can technically be defined as herbaceous types.

Related Concepts:

ELEMENT DESCRIPTION

Environment: This group occurs throughout the Intermountain West from the western Great Basin to the Northern Rocky Mountains and Colorado Plateau at elevations ranging from 300 m up to 2500 m. The climate where this group occurs is generally hot in summers and cold in winters with low annual precipitation, ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variations. Sites are generally alluvial fans and flats with moderate to deep soils. Some sites can be flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983e). Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium; deep, fine to medium-textured alluvial soils with some source of subirrigation during the summer season, or sandstone talus over shale. Soils may be alkaline and typically moderately saline (West 1983e).

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Vegetation: The most important shrubs in this group include *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, and *Atriplex canescens*. Other commonly present to codominant species include *Ephedra viridis*, *Ephedra torreyana*, *Tetradymia canescens*, *Coleogyne ramosissima*, *Fallugia paradoxa*, *Isocoma drummondii*, *Opuntia* spp., *Eriogonum* spp., *Grayia spinosa*, *Lycium pallidum*, *Purshia tridentata*, and *Artemisia* spp. Semi-desert grasses are common, including *Achnatherum hymenoides*, *Aristida purpurea*, *Leymus salinus* ssp. *salinus*, *Pleuraphis jamesii*, *Poa secunda*, *Pseudoroegneria spicata*, *Elymus elymoides*, *Muhlenbergia pungens*, and *Hesperostipa comata*. Perennial forbs may include *Phlox hoodii*, *Sphaeralcea coccinea*, *Sphaeralcea munroana*, *Achillea millefolium*, *Astragalus purshii*, *Calochortus macrocarpus*, *Chamaesyce* spp., and *Erigeron* spp. Annuals may be seasonally present to abundant depending on precipitation and disturbance. Exotic annuals such as *Bromus tectorum* or *Salsola kali* can be abundant.

Dynamics:**Similar Associations:****Similar Association Comments:****Adjacent Associations:****Adjacent Association Comments:****Other Comments:**

Wildlife Habitat: The Non-sage Shrubland Shrubland Group is typically an early-seral stage of sagebrush plant communities. After disturbance removes the sagebrush canopy, sprouting shrubs such as rabbitbrush may rapidly increase on the site. These shrubs slowly drop out of the community as sagebrush reinvades. In wildlife-habitat relationships work, or habitat planning on National Wildlife Refuges, grasslands and sagebrush are often lumped into a single habitat type termed “shrub-steppe” or “sagebrush.” These habitat types may include a continuum of seral stages within the plant communities, ranging from grasslands, to rabbitbrush and associated shrubs, to various amounts of sagebrush. There tends to be a high degree of overlap with wildlife species occupying these open, upland plant communities. With the exception of sagebrush-obligates species which do not persist without sagebrush, many species may be found within this continuum of plant communities. Presence of individual wildlife species may depend on the amount and height of shrub and grass cover. See Desert Grassland Group and Tall Sagebrush Group for descriptions.

USFWS Region1 Habitat Types:

Description Author: M.E. Hall and M.S. Reid **Version:** 19-Mar-2010

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ELEMENT GLOBAL RANK & REASONS**GRank:** GNR **GRank Review Date:** 19-Mar-2010**GReasons:****Ranking Author:** **Version:****ELEMENT DISTRIBUTION**

Range: This group occurs throughout the intermountain western U.S., typically at lower elevations, and extends into Wyoming and Montana across the Great Divide Basin. It barely gets as far north as north-central Montana.

Nations: US**Subnations:** AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY

TNC Ecoregion	Status Pattern	Distribution	Note
4-Modoc Plateau and East Cascades	C		
6-Columbia Plateau	C		
8-Middle Rockies - Blue Mountains	C		
9-Utah-Wyoming Rocky Mountains	C		
10-Wyoming Basins	C		
11-Great Basin	C		
18-Utah High Plateaus	C		
19-Colorado Plateau	C		
20-Southern Rocky Mountains	C		
21-Arizona-New Mexico Mountains	C		

USFS Ecoregions:**Federal Lands:** NPS (Arches)**ELEMENT SOURCES**

References: Branson et al. 1976, Faber-Langendoen et al. 2011, Hanson 1929, Johnson and O'Neil 2000, Shiflet 1994, Tuhy et al. 2002, West 1983e, Western Ecology Working Group n.d.

Intermountain Semi-Desert Grassland Group

G311—DESERT GRASSLAND GROUP

James' Galleta - Indian Ricegrass - Needle-and-Thread Semi-Desert Grassland Group

Intermountain Semi-Desert Grassland Group

Classif. Resp.: West

Classif. Level: Group Conf.: 2 - Moderate Stakeholders: West

Status: Standard

Concept Auth.: N.E. West (1983e)

Concept Ref.: West 1983e

ELEMENT CONCEPT

Summary: This widespread group includes semi-arid to arid grasslands throughout the intermountain western U.S. They occur on sites over an elevational range of approximately 1100 to 3290 m in most of its range and 350 to 425 m in the Columbia Basin on a variety of landforms, including swales, playas, mesas, alluvial flats, and plains. This group may constitute the matrix over large areas of intermountain basins, and also may occur as large patches in mosaics with semi-desert shrublands. Grasslands in areas of higher precipitation, at higher elevation, typically belong to other groups. Substrates are often well-drained sandy or loam soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. The dominant perennial bunch grasses and shrubs within this group are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Achnatherum nelsonii*, *Achnatherum speciosum*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa cusickii*, *Poa secunda*, and *Pseudoroegneria spicata*. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*, which are the typical dominant species of adjacent shrublands.

Classification Comments: This group should possibly be merged with the ~Columbia Basin Foothill & Canyon Dry Grassland Group (G274)\$\$, which is very similar compositionally and may be a northern variant of this intermountain group. Communities dominated by *Achnatherum lettermanii*, *Achnatherum nelsonii*, and *Agrostis variabilis* are poorly understood and require further documentation. The only occurrence of a community dominated by *Agrostis variabilis* is known from Utah and may be the result of disturbance. *Achnatherum speciosum* is a southern Great Basin species, which extends in distribution into the Mojave and Colorado deserts, for now its communities are included here. Occurrences of this semi-desert grassland group in the relatively high-elevation basins of Wyoming and south-central Montana resemble in species composition the foothill grasslands that grow at slightly higher elevations and in the Columbia Plateau.

Related Concepts:

- Grama - Galleta (502) (Shiflet 1994) <

ELEMENT DESCRIPTION

Environment: Low-elevation grasslands in the Intermountain West region occur in semi-arid to arid climates at approximately 1450 to 2320 m (4750-7610 feet) elevation, but can reach as low as 350 m in the Columbia Basin. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesatops, plateau parks, alluvial flats, and plains. These grasslands typically occur on xeric sites. This group experiences cold temperate conditions. Hot summers and cold winters with freezing temperatures and snow are common. Annual precipitation is usually from 20-40 cm (7.9-15.7 inches). A significant portion of the precipitation falls in July through October during the summer monsoon storms, with the rest falling as snow during the winter and early spring months. These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep. Soils supporting this group also vary from deep to shallow, and from sandy to finer-textured. The substrate is typically derived from sandstone or shale. Some occurrences on sandy soils have a high cover of cryptogams on the soil surface. These cryptogams tend to increase the stability of the highly erodible sandy soils of these grasslands during torrential summer rains and heavy wind storms (Kleiner and Harper 1977).

Vegetation: The dominant perennial bunch grasses and shrubs within this group are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Achnatherum nelsonii*, *Achnatherum speciosum*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa cusickii*, *Poa secunda*, and *Pseudoroegneria spicata*. Other graminoids may include *Aristida purpurea*, *Carex filifolia*, *Elymus elymoides*, *Koeleria macrantha*, *Leymus salinus*, or *Sporobolus cryptandrus*. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. Forb cover is also sparse but can be relatively diverse. Common forbs are *Gaura coccinea*, *Balsamorhiza sagittata*, *Hymenopappus filifolius*, *Machaeranthera canescens*, *Sphaeralcea coccinea*, *Vicia americana*, *Lappula occidentalis* (= *Lappula redowskii*), *Lithophragma glabrum*, *Lupinus pusillus*, *Opuntia aurea* (= *Opuntia basilaris* var. *aurea*), *Opuntia polyacantha*, *Plantago patagonica*, *Pediomelum argophyllum*, *Artemisia campestris*, *Artemisia dracunculus*, *Artemisia ludoviciana*, and species of *Antennaria*, *Astragalus*, *Cryptantha*, *Eriogonum*, *Gilia*, and *Lappula*. Cryptogams are important in some stands with up to 40% ground cover on sites in the Colorado Plateau. Exotic species such as *Bromus tectorum*, *Draba verna*, *Lactuca serriola*, *Salsola tragus*, *Bassia scoparia* (= *Kochia scoparia*), *Poa pratensis*, *Sisymbrium altissimum*, and *Tragopogon dubius* are present in many of these stands.

Dynamics: *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. (USFS 1937). It is also a valuable forage grass in arid and semi-arid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USDA 1937). *Hesperostipa comata* is a deep-rooted grass that uses soil moisture below 0.5 m during the dry summers. Burning generally kills or severely damages *Hesperostipa comata* plants. After fire, regeneration of this non-rhizomatous bunchgrass is through seed and may take many years to reach prefire densities. *Pleuraphis jamesii* is both drought- and grazing-resistant (USFS 1937, Weaver and Albertson 1956, West et al. 1972). In parts of its range it increases under grazing, and in others parts it decreases. The grass is favored in mixedgrass stands because it is only moderately palatable to

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livestock, but decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West et al. 1972). This grass reproduces extensively from scaly rhizomes. These rhizomes make the plant resistant to trampling by livestock and have good soil binding properties (USFS 1937, Weaver and Albertson 1956, West et al. 1972). The cool-season annual grass *Bromus tectorum* can be an effective competitor for winter soil moisture because it can germinate in the fall, over-winter, then begin re-growing in the early spring before it is warm enough for many perennial grasses, completing its lifecycle and depleting soil moisture before the dry summer weather begins. This annual species also produces abundant fine fuels that carry fire well and increase the frequency of fires (FEIS 1998).

Similar Associations:

- *Festuca campestris* - *Festuca idahoensis* - *Pseudoroegneria spicata* Northern Rocky Mountain Foothill Grassland Group (G273)
- *Sporobolus cryptandrus* - *Poa secunda* Columbia Basin Dry Grassland Group (G274)

Similar Association Comments:**Adjacent Associations:****Adjacent Association Comments:****Other Comments:**

Wildlife Habitat: The desert grassland group often appears on the landscape in juxtaposition with sagebrush-dominated groups. In many cases grasslands are an early seral stage of sagebrush-dominated plant communities, where the sagebrush has been removed by disturbance. In wildlife-habitat relationships work, or habitat planning on National Wildlife Refuges, grasslands and sagebrush are often lumped into a single habitat type termed “shrub-steppe” or “sagebrush.” These habitat types may include early seral sites dominated by grasses and forbs to a late seral state dominated by mature shrubs. Sagebrush sites that have been converted to annual grasslands, such as cheatgrass, may be included in this habitat type as well. There tends to be a high degree of overlap with wildlife species occupying these open, upland plant communities. With the exception of sagebrush-obligates species which do not persist without sagebrush, many species may be found in both desert grassland and tall sagebrush plant communities. Presence of individual wildlife species may depend on the amount and height of shrub and grass cover.

Burrowing mammals such as ground squirrels (*Spermophilus* spp.) and badger (*Taxidea taxus*) will breed and forage in grasslands provided suitable soil is present for burrowing. If suitable burrows are present, burrowing owl (*Athene cunicularia*) will use grasslands as well. Small mammal species commonly breeding and feeding in grasslands include deer mouse (*Peromyscus maniculatus*), montane vole (*Microtus montanus*) and western jumping mouse (*Zapus princeps*).

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For large mammals, pronghorn (*Antilocapra americana*), a species of open country, commonly breed and forages in grasslands. Mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus elaphus*) also may feed in this habitat, provided suitable breeding sites are nearby.

A variety of ground-nesting birds breed and forage in grasslands, including western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), grasshopper sparrow (*Ammodramus savannarum*), and long-billed curlew (*Numenius americanus*). Several raptor species will feed in grasslands, providing appropriate habitat elements for nesting, such as cliffs and trees, are nearby. These include ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*) and long-eared owl (*Asio otus*). Northern harrier (*Circus cyaneus*) may forage in grasslands, but needs wetlands or wet meadows nearby for nesting.

USFWS Region1 Habitat Types: sagebrush steppe, sagebrush/shrub-steppe, big sagebrush, sagebrush lowland, low sagebrush shrublands and steppes, native perennial grassland, native short grassland

Description Author: M.E. Hall and M.S. Reid **Version:** 19-Mar-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 19-Mar-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This group occurs throughout the intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) elevation. In the Bighorn Basin of north-central Wyoming, there may be some desert grasslands, but this is uncertain.

Nations: US

Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

TNC Ecoregion	Status Pattern	Distribution	Note
4-Modoc Plateau and East Cascades	C		
6-Columbia Plateau	C		
8-Middle Rockies - Blue Mountains	C		
9-Utah-Wyoming Rocky Mountains	C		
10-Wyoming Basins	C		
11-Great Basin	C		
18-Utah High Plateaus	C		
19-Colorado Plateau	C		
20-Southern Rocky Mountains	C		
21-Arizona-New Mexico Mountains	C		

USFS Ecoregions:

Federal Lands: NPS (Arches)

ELEMENT SOURCES

References: Cable 1967, Cable 1969, Cable 1975b, FEIS 1998, Faber-Langendoen et al. 2011, Johnson and O'Neil 2000,

Kleiner and Harper 1972, Kleiner and Harper 1977, McClaran and Van Devender 1995, Maser et al. 1984, Shiflet 1994, USFS 1937, Weaver and Albertson 1956, West 1983e, West et al. 1972, Western Ecology Working Group n.d.

Great Basin & Intermountain Ruderal Dry Shrubland & Grassland**G600—INTRODUCED DRY-MESIC HERBACEOUS SPECIES*****Great Basin & Intermountain Ruderal Dry Shrubland & Grassland*****Classif. Level:** Group **Conf.:** **Stakeholders:****Status:** Standard**Concept Auth.:** Faber-Langendoen et al.**Concept Ref.:** Faber-Langendoen et al. 2011**ELEMENT CONCEPT****Summary:****Classification Comments:****Related Concepts:****ELEMENT DESCRIPTION****Environment:****Vegetation:****Dynamics:****Similar Associations:****Similar Association Comments:****Adjacent Associations:****Adjacent Association Comments:****Other Comments:**

Wildlife Habitat: In general, crested wheatgrass seedings are characterized by low plant diversity, and thus by low wildlife diversity. With appropriate soils, the Great Basin spadefoot (*Spea intermontana*) may breed and forage in this habitat type. Pronghorn (*Antilocapra americana*), western rattlesnake (*Crotalus oreganus*), common raven (*Corvus corax*), horned lark (*Eremophila alpestris*), and grasshopper sparrow (*Ammodramus savannarum*) breed and forage as well. A variety of generalist wildlife species may forage in this plant community, including turkey vulture (*Cathartes aura*), prairie falcon (*Falco mexicanus*), barn swallow (*Hirundo rustica*), western meadowlark (*Sturnella neglecta*), and black-tailed jackrabbit (*Lepus californicus*).

USFWS Region1 Habitat Types:

Camas NWR Vegetation Inventory, Classification, and Mapping

Description Author: **Version:**

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 8-Apr-2011

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range:

Nations:

Subnations:

TNC Ecoregion	Status Pattern	Distribution	Note
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USFS Ecoregions:

Federal Lands:

ELEMENT SOURCES

References: Faber-Langendoen et al. 2011, Johnson and O'Neil 2000, Maser et al. 1984,

Intermountain Dry Tall Sagebrush Shrubland

G303—TALL SAGEBRUSH GROUP

Wyoming Big Sagebrush - Basin Big Sagebrush Tall Shrubland Group

Intermountain Dry Tall Sagebrush Shrubland

Classif. Level: Group **Conf.:** 2 - Moderate **Stakeholders:** Canada, Midwest, West

Status: Standard

Concept Auth.: N.E. West (1983a)

Concept Ref.: West 1983a

ELEMENT CONCEPT

Summary: This shrubland and shrub herbaceous group is widely distributed from the Great Basin, Columbia River Basin, Colorado Plateau, northern Rocky Mountains, northeastern Great Plains and as far east as the Dakotas at elevations as low as 500 m in the northwestern Great Plains to 2500 m in the Rocky Mountains and Colorado Plateau. This group occurs on flat to steeply sloping upland slopes on alluvial fans and terraces, toeslopes, lower and middle slopes, draws, badlands, and foothills. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils. Climate ranges from arid in the western Great Basin to subhumid in the northern plains and Rocky Mountains with much of the precipitation falling primarily as snow. The amount and reliability of growing-season moisture increase eastward and with increasing elevation. Stands are dominated by *Artemisia tridentata* ssp. *wyomingensis* and *Artemisia tridentata* ssp. *tridentata* and, in some cases, codominated by *Amelanchier utahensis*, *Atriplex canescens*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria nauseosa*, or *Sarcobatus vermiculatus*. Other common shrubs include *Artemisia frigida*, *Atriplex confertifolia*, *Atriplex gardneri*, *Chrysothamnus* spp., *Ericameria* spp., *Grayia spinosa*, *Krascheninnikovia lanata*, *Peraphyllum ramosissimum*, *Prunus virginiana*, *Purshia tridentata*, *Symphoricarpos longiflorus*, and *Tetradymia* spp. The herbaceous layer may be sparse to strongly dominated by graminoids including *Achnatherum hymenoides*, *Achnatherum lettermanii* (= *Stipa lettermanii*), *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Bromus tectorum*, *Carex filifolia*, *Elymus albicans*, *Elymus elymoides*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Leymus ambiguus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. A sparse layer of cold-deciduous needle-leaved or scale-leaved evergreen trees may occasionally be emergent over the shrubs.

Classification Comments: This group tends to occur in drier biophysical settings than the two similar tall sagebrush groups (G302, G304). Hence, it tends to have a less abundant herbaceous component, with the predominant grasses being more adapted to drier conditions. In addition, the co-occurring shrub taxa will include more desert species as well as cacti. This is a slid group in concept, but the specific associations included in it need to be reviewed and will require some adjustment.

Related Concepts:

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- Basin Big Sagebrush (401) (Shiflet 1994) ><
- Big Sagebrush - Bluebunch Wheatgrass (314) (Shiflet 1994) ><
- Big Sagebrush - Idaho Fescue (315) (Shiflet 1994) ><
- Great Basin Desertscrub, Sagebrush Series - 152.11 (Brown et al. 1979) >
- Great Basin Desertscrub, Sagebrush Series, *Artemisia tridentata* Association - 152.111 (Brown et al. 1979) >
- SS Big Sagebrush Shrub/Grassland (Ecosystems Working Group 1998) > [low-elevation sites; high elevation.]
- Wyoming Big Sagebrush (403) (Shiflet 1994) ><

ELEMENT DESCRIPTION

Environment: This shrubland group is widely distributed in the western U.S., at elevations as low as 500 m in the northwestern Great Plains to 2500 m in the Rocky Mountains and Colorado Plateau. This group occurs on flat to steeply sloping upland slopes on alluvial fans and terraces, toeslopes, lower and middle slopes, draws, badlands, and foothills. *Climate:* Climate ranges from arid in the western Great Basin to subhumid in the northern plains and Rocky Mountains with much of the precipitation falling primarily as snow. The amount and reliability of growing-season moisture increase eastward and with increasing elevation. *Soil/substrate/hydrology:* Sites with little slope tend to have deep soils while those with steeper slopes have shallow to moderately deep soils. Soil texture is loamy sand, loam, sandy loam, or clay loam (Hansen and Hoffman 1988), and there is often a significant amount of coarse fragments in the soil profile.

Vegetation: Stands are dominated by *Artemisia tridentata* ssp. *wyomingensis* and *Artemisia tridentata* ssp. *tridentata* and, in some cases, codominated by *Atriplex canescens*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria nauseosa*, *Amelanchier utahensis*, or *Sarcobatus vermiculatus*. Other common shrubs include *Artemisia frigida*, *Atriplex confertifolia*, *Atriplex gardneri*, *Chrysothamnus* spp., *Ericameria* spp., *Grayia spinosa*, *Krascheninnikovia lanata*, *Peraphyllum ramosissimum*, *Prunus virginiana*, *Purshia tridentata*, *Symphoricarpos longiflorus*, and *Tetradymia* spp. A sparse layer of cold-deciduous needle-leaved or scale-leaved evergreen trees may occasionally be emergent over the shrubs. The herbaceous layer may be sparse to strongly dominated by graminoids including *Achnatherum hymenoides*, *Achnatherum lettermanii* (= *Stipa lettermanii*), *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Bromus tectorum*, *Carex filifolia*, *Elymus albicans*, *Elymus elymoides*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Leymus ambiguus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Trees found across the range include *Pinus ponderosa*, *Pinus flexilis*, *Pinus jeffreyi*, *Pinus monophylla*, *Pinus edulis*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Juniperus monosperma*, *Populus tremuloides*, *Quercus garryana*, *Quercus gambelii*, *Cercocarpus ledifolius*, and *Yucca brevifolia*.

Dynamics: The natural fire regime of this group likely maintains patchy distribution of shrubs, so the general aspect of the vegetation is that of a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Response to grazing can be variable depending on the type of grazer and the season in which grazing occurs. *Hesperostipa comata*

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can increase in abundance in response to either grazing or fire. Microphytic crust is very important in this group.

Similar Associations:

- *Artemisia tridentata* - *Artemisia tripartita* - *Purshia tridentata* Big Sagebrush Steppe Group (G302)
- *Artemisia tridentata* ssp. *spiciformis* - *Artemisia tridentata* ssp. *vaseyana* - *Artemisia cana* ssp. *viscidula* Tall Shrubland & Steppe Group (G304)

Similar Association Comments:

Adjacent Associations:

Adjacent Association Comments:

Other Comments:

Wildlife Habitat: The tall sagebrush group often appears on the landscape in juxtaposition with desert grassland groups. In many cases grasslands are an early seral stage of sagebrush-dominated plant communities, where the sagebrush has been removed by disturbance. In wildlife-habitat relationships work, or habitat planning on National Wildlife Refuges, grasslands and sagebrush are often lumped into a single habitat type termed “shrub-steppe” or “sagebrush.” These habitat types may include early seral sites dominated by grasses and forbs to a late seral state dominated by mature shrubs. Sagebrush sites that have been converted to annual grasslands, such as cheatgrass, may be included in this habitat type as well. There tends to be a high degree of overlap with wildlife species occupying these open, upland plant communities. With the exception of sagebrush-obligates species which do not persist without sagebrush, many species may be found in both desert grassland and tall sagebrush plant communities. Presence of individual wildlife species may depend on the amount and height of shrub and grass cover.

Sagebrush obligate species do not persist in an area without sagebrush. Sagebrush obligates include pygmy rabbit (*Brachylagus idahoensis*), sagebrush vole (*Lemmyscus curtatus*), greater sage-grouse (*Centrocercus urophasianus*), sage thrasher (*Oreoscoptes montanus*), sage sparrow (*Amphispiza belli*), and Brewer’s sparrow (*Spizella breweri*).

Burrowing mammals, such as ground squirrels (*Spermophilus* spp.) and badger (*Taxidea taxus*) will breed and forage in sagebrush provided suitable soil is present for burrowing. The deer mouse (*Peromyscus maniculatus*), montane vole (*Microtus montanus*) and western jumping mouse (*Zapus princeps*) may breed and forage in grasslands as well.

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Pronghorn (*Antilocapra americana*), a species of open country, commonly breed and forage in sagebrush. Mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus elaphus*) may forage as well, provided suitable breeding sites are nearby.

A variety of ground-nesting bird species breed and feed in sagebrush, including western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), and grasshopper sparrow (*Ammodramus savannarum*). Several raptor species feed in sagebrush, providing appropriate habitat elements for nesting such as cliffs and trees are nearby. These include ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), and prairie falcon (*Falco mexicanus*). Northern harrier (*Circus cyaneus*) may forage in low and open sagebrush stands, but needs wetlands or wet meadows nearby for nesting.

USFWS Region1 Habitat Types: sagebrush steppe, sagebrush/shrub-steppe, big sagebrush, sagebrush lowland, low sagebrush shrublands and steppes

Description Author: M. E. Hall and K.A. Schulz **Version:** 26-Mar-2010

ELEMENT GLOBAL RANK & REASONS

GRank: GNR **GRank Review Date:** 26-Mar-2010

GReasons:

Ranking Author: **Version:**

ELEMENT DISTRIBUTION

Range: This shrubland and shrub herbaceous group is widely distributed from the Great Basin, Columbia River Basin, Colorado Plateau, northern Rocky Mountains, northeastern Great Plains and as far east as the Dakotas.

Nations: CA, US

Subnations: BC, CA, CO, ID, MT, ND, NV, OR, SD?, UT, WA, WY

TNC Ecoregion	Status Pattern	Distribution	Note
4-Modoc Plateau and East Cascades	C		
6-Columbia Plateau	C		

Appendix 5: Citations for NVCS Descriptions

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Appendix 6: Field Forms

Upland Field Form used at Camas NWR

Assessment Code: 10.604 L2.102

General Description Form (arrows below indicate info you should have with you, if available)

A. GENERAL INFORMATION page 12		B. LOCATION page 13	
Site Name: <u>890</u>	Directions (if new site): <u>Camas NWR</u> or <input type="checkbox"/> Use EO Site Name: <u>Sagebrush steppe</u> <u>SW CORNWY</u>	State / County: <u>Id. Jefferson</u>	
L2 Assessment Code (e.g. NY.DFL.L2.001): <u>10.604 L2.102</u>	State EO Code (office) (e.g. EO ID):	USGS quad name(s) (Office):	
Date: <u>30 11.08.18</u> YEAR MONTH DAY	GPS Unit: <u>21MB Trimble</u>		
Photographer: <u>RO-GIS</u> <u>RACE</u>	UTM Zone: <u>12</u>	Datum: <u>NAD 83</u>	Accuracy:
Team Members: Leader: <u>Fumerson</u> Co-leader: <u>Barnett</u> Assistant(s):	UTME: OR Lat/dec deg: <u>396027</u>	Write one centrally located coordinate; store rest in GPS.	
Owner(s) (office) (individual):	UTMN: OR Long/dec deg: <u>4860592</u>		

D. GENERAL DESCRIPTION (be brief, use Sections E and F if details desired) page 15
Include description of what defines the boundaries of the assessment area; that is, what is adjacent to the area being assessed.

Relatively flat, with slight rise. Area along, west to ridge. Rabbit brush patch south of point and just outside of the plot. Rabbit br. canopy more open with heads and lateral canopy. Grass sparse below sage canopy.

Other Types Of Interest at Site: (note types of interest for future visits to this site.) only the important habitat with, except shrub/scrub patch on south west side of polygon.

Did you complete these optional sections on the following page?

E. General Drawing ☐ Y ☐ N F. Detailed Overview ☐ Y ☐ N

chui = green rabbit brush
stco = Stipa comata (I am old manish)

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Assessment Code: 1.0. GAK L2. 1.0. 2

OPTIONAL PAGE: PLEASE INDICATE USE WITH "Y" or "N" ON PREVIOUS PAGE

E. GENERAL DRAWING page 15

Provide a drawing of the assessment area, including its boundaries, as either aerial view or transect view.



F. DETAILED DESCRIPTION page 15

LANDSCAPE CONTEXT AND BUFFER DESCRIPTION

What's your impression of the condition/integrity of the buffer? Circle one: Excellent, Good, Fair, Poor. Comments:

SIZE DESCRIPTION (Assess Size of Assessment Area, and the full extent of the area occupied by the type).

ON-SITE COMMENTS (overall description of the community/ecosystem)

Landscape Pattern (within AA) Description

Vegetation Description Sage canopy covers 15-20%. Grass understory sparseHydrology Description upland siteSoils Description Sandy & mid size basalt rocks surfaceAnimal Description Peregrine falcons, Salix bees, Spotted winged

What's your impression of the condition/integrity of the on-site community/ecosystem? Circle one: Excellent, Good, Fair, Poor. Comments:

Compare to EO rank?

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Assessment Code: 10-G-95 L2.102

ENVIRONMENTAL PROFILE page 18ff		
<p>Elevation (topo map): _____ m / _____ ft</p> <p>Slope: _____ deg / _____ % or <input type="checkbox"/> flat to <1%</p> <p>Aspect (compass direction degrees) downslope _____ or _____ if variable Or _____ none (if flat)</p> <p>Landform Comment (optional): <u>Flat, low, with some vegetation</u></p>	<p>Hydrologic Regime (pg 21): [WT=water table; GS=growing season] Saturated: saturated to surface for extended periods during GS; surface water seldom present, isolated pools may be present. Seasonally saturated: saturated to surface but absent by end of most GS Permanently flooded: water covers surface throughout year in all years Semipermanently flooded: water covers surface and persists throughout GS in most years (excl. droughts); when absent, WT usually at/very near surface Seasonally flooded: water covers surface and is present early in GS, but absent late in season in most years; when absent, WT often near surface Temporarily flooded: water covers surface for brief periods in GS, but WT usually well below surface for most of season; upland & wetland plants present Intermittently flooded: flooded for variable periods without detectable seasonal periodicity; months or years may occur between floods Tidally flooded: flooded by the diurnal rise and fall of the surface of oceans and seas, and the tides, rivers, etc. 50116060 W then Artificially flooded: flooding by pumps, siphons, etc. not "natural." See manual <input checked="" type="checkbox"/> Never inundated <input type="checkbox"/> Unknown</p>	<p>Hydrological Condition (pg 12) a. Current Water Depth, approx deepest point: _____ (nearest 0.5 m) b. Estimated High Water Depth: From surface water or soil surface (nearest 0.5 m): _____ Evidence of high water depth: _____</p>
<p>Organic Soil (pg 19) ____ muck, sapric (von Post 7-10) ____ peat, hemic (von Post 4-6) ____ peat, fibric (von Post 1-3) Von Post scale of peat decomposition: _____</p>	<p>Soil Drainage (pg 21): <input checked="" type="checkbox"/> Rapidly Drained: no gleying in entire profile; typically coarse textured or on steep slope <input type="checkbox"/> Well Drained: usually free of mottling in upper 2'; if red, brown, or yellowish <input type="checkbox"/> Moderately Well Drained: commonly mottled in lower B and C or below 2" <input type="checkbox"/> Somewhat Poorly Drained: soil moisture in excess of field capacity remains in horizon for moderately long periods during year; commonly mottled in B and C <input type="checkbox"/> Poorly Drained: soil moisture in excess of field capacity in all horizons for large part of year; soils usually very strongly gleyed <input type="checkbox"/> Very Poorly Drained: free water remains at/within 12" of surface most of year; strongly gleyed</p>	<p>Water Source (pg 22): Pick one primary (write "1"), up to two others ("2"), as needed. <input checked="" type="checkbox"/> Direct precipitation <input type="checkbox"/> Surface/overland flow: run-off <input type="checkbox"/> Groundwater ____ Discharge: released into wetland ____ Saturation: wetland near WT surface <input type="checkbox"/> Water body inundation: surface water from marsh/swamp due to adjacent river/lake <input type="checkbox"/> Overbank flow: flooding river/stream <input type="checkbox"/> Inbank flow: contained within river channel <input type="checkbox"/> Anthropogenic ____ Direct input: irrigation, pumped ____ Overland flow: urban ____ Overland flow: rural ____ Other (describe): _____</p>
<p>Mineral Soil (pg 20) Texture (A - or top - horizon): ____ SANDY _____ sand _____ loamy sand <input checked="" type="checkbox"/> SANDY LOAM _____ sandy loam ____ LOAMY _____ loam _____ silty loam ____ CLAYEY _____ clay loam _____ silty clay loam ____ silty clay _____ clay</p>	<p>HGM Class (pg 25): Pick one primary (write "1"); if needed, pick a secondary (write "2") ____ Riverine ____ Depressional ____ Slope ____ Mineral Soil Flats ____ Organic Soil Flats ____ Estuarine Fringe ____ Lacustrine Fringe</p>	<p>HGM Class Comments:</p>
<p>Unvegetated Surface (pg 18) (does not need to add to 100%; mentally remove plant layers; ignore below water): <input checked="" type="checkbox"/> % Surface Water <input type="checkbox"/> % Litter, duff, small wood < 10 cm dbh <input type="checkbox"/> % Wood > 10 cm dbh <input type="checkbox"/> % Rock <input type="checkbox"/> % Bare surface <input type="checkbox"/> % Other (describe): _____</p>	<p>Environmental Comments (any other characteristics worth noting, e.g., stoniness, hardpans, drainage, water flow):</p>	

Finest Level Mapped	CCPName	EcologicalSystem	Class	Divison	Formation
Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native	Shrub Steppe	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland & Grassland	Western North American Cool Semi-Desert Scrub & Grassland	Temperate Grassland, Meadow & Shrubland
Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal	Shrub Steppe	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland & Grassland	Western North American Cool Semi-Desert Scrub & Grassland	Temperate Grassland, Meadow & Shrubland
Intermountain Semi-Desert Grassland & Steppe Group	Shrub Steppe	Inter-Mountain Basins Semi-Desert Grassland	Shrubland & Grassland	Western North American Cool Semi-Desert Scrub & Grassland	Temperate Grassland, Meadow & Shrubland
Green Rabbitbrush Shrubland and Steppe Alliance	Shrub Steppe	Inter-Mountain Basins Semi-Desert Shrub Steppe	Shrubland & Grassland	Western North American Cool Semi-Desert Scrub & Grassland	Temperate Grassland, Meadow & Shrubland
Crested Wheatgrass Ruderal Grassland Alliance	Upland Non-Native	Introduced Upland Vegetation - Perennial Grassland and Forbland	Shrubland & Grassland	Western North American Cool Semi-Desert Scrub & Grassland	Temperate Grassland, Meadow & Shrubland
Great Basin & Intermountain Ruderal Dry Shrubland & Grass	Upland Non-Native	Introduced Upland Vegetation - Perennial Grassland and Forbland	Shrubland & Grassland	Western North American Cool Semi-Desert Scrub & Grassland	Temperate Grassland, Meadow & Shrubland
Russian Olive Alliance	Riparian	Introduced Upland Vegetation - Treed	Cultural Woody Vegetation	Cultural Woody Vegetation	Cultural Woody Vegetation
Crack Willow Alliance	Hemi-Marsh	Introduced Upland Vegetation - Treed	Cultural Woody Vegetation	Cultural Woody Vegetation	Cultural Woody Vegetation
Common Spike-Rush Herbaceous Alliance	Hemi-Marsh	North American Arid West Emergent Marsh	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Hard-Stem Bull-Rush Herbaceous Alliance	Hemi-Marsh	North American Arid West Emergent Marsh	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Broadleaf Cattail Herbaceous Alliance	Hemi-Marsh	North American Arid West Emergent Marsh	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
River Bottom Active Channel, Transitionally Vegetated	Open Water	Open Water	Open Water	Open Water	Open Water
Native Sedge Montane Wet Meadow Alliance	Wet Meadow	Rocky Mountain Alpine-Montane Wet Meadow	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Western North American Ruderal Wet Meadow & Marsh Group	Lowland Non-Native	Rocky Mountain Alpine-Montane Wet Meadow	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Baltic Rush Herbaceous Alliance	Wet Meadow	Rocky Mountain Alpine-Montane Wet Meadow	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Narrow-Leaf Willow Shrubland Alliance	Riparain	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Amaranth Mudflat Sparse Herbaceous Alliance	Open Water	Temperate Pacific Freshwater Mudflat	Shrubland & Grassland	Western North American Freshwater Wet Meadow & Marsh	Temperate & Boreal Freshwater Wet Meadow & Marsh
Agricultural	Hay	Pasture/Hay	Agricultural	Agricultural	Agricultural
Developed	Developed	Developed, Low Intensity	Developed	Developed	Developed
Open Water	Open Water	Open Water	Open Water	Open Water	Open Water
Cultural Woody Vegetation	Shelterbelt	Introduced Upland Vegetation - Treed	Cultural Woody Vegetation	Cultural Woody Vegetation	Cultural Woody Vegetation
Non-Vegetated	Shrub Steppe	Non-Vegetated	Non-Vegetated	Non-Vegetated	Non-Vegetated
Senescent Vegetation Dominant (Litter)	Hemi-Marsh	Non-Vegetated	Non-Vegetated	Non-Vegetated	Non-Vegetated
Cultural Woody Vegetation	Shelterbelt	Introduced Upland Vegetation - Treed	Cultural Woody Vegetation	Cultural Woody Vegetation	Cultural Woody Vegetation

Table 7. Crosswalk of finest mapping level to CCP names, Ecological Systems, and levels of the NVC.

Finest Level Mapped (con't)	CCPName	Group	Alliance	Association	MacroGroup
Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native	Shrub Steppe	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native	Not mapped to alliance level	Not mapped to association level	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe
Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal	Shrub Steppe	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal	Not mapped to alliance level	Not mapped to association level	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe
Intermountain Semi-Desert Grassland & Steppe Group	Shrub Steppe	Intermountain Semi-Desert Grassland & Steppe Group	Not mapped to alliance level	Not mapped to association level	Great Basin & Intermountain Dry Shrubland & Grassland
Green Rabbitbrush Shrubland and Steppe Alliance	Shrub Steppe	Intermountain Semi-Desert Shrubland Group	Green Rabbitbrush Shrubland and Steppe Alliance	Not mapped to association level	Great Basin & Intermountain Dry Shrubland & Grassland
Crested Wheatgrass Ruderal Grassland Alliance	Upland Non-Native	Great Basin & Intermountain Ruderal Dry Shrubland & Grassland Group	Crested Wheatgrass Ruderal Grassland Alliance	Not classified or mapped to association level	Western North American Ruderal Dry Shrubland & Grassland Macro-Group
Great Basin & Intermountain Ruderal Dry Shrubland & Grass	Upland Non-Native	Great Basin & Intermountain Ruderal Dry Shrubland & Grass	Not mapped to alliance level	Not mapped to association level	Western North American Ruderal Dry Shrubland & Grassland Macro-Group
Russian Olive Alliance	Riparian	Cultural Woody Vegetation	Russian Olive Alliance	Russian Olive	Cultural Woody Vegetation
Crack Willow Alliance	Hemi-Marsh	Cultural Woody Vegetation	Crack Willow Alliance	Crack Willow	Cultural Woody Vegetation
Common Spike-Rush Herbaceous Alliance	Hemi-Marsh	Western North American Temperate Interior Freshwater Marsh Group	Common Spike-Rush Herbaceous Alliance	Eleocharis palustris Herbaceous Vegetation	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
Hard-Stem Bull-Rush Herbaceous Alliance	Hemi-Marsh	Western North American Temperate Interior Freshwater Marsh Group	Hard-Stem Bull-Rush Herbaceous Alliance	Schoenoplectus acutus Herbaceous Vegetation	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
Broadleaf Cattail Herbaceous Alliance	Hemi-Marsh	Western North American Temperate Interior Freshwater Marsh Group	Broadleaf Cattail Herbaceous Alliance	Not mapped to association level	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
River Bottom Active Channel, Transitionally Vegetated	Open Water	Open Water	Open Water	Open Water	Open Water
Native Sedge Montane Wet Meadow Alliance	Wet Meadow	Vancouverian & Rocky Mountain Montane Wet Meadow Group	Native Sedge Montane Wet Meadow Alliance	Not mapped to association level	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
Western North American Ruderal Wet Meadow & Marsh Group	Lowland Non-Native	Western North American Ruderal Wet Meadow & Marsh Group	Not mapped to alliance level	Not mapped to association level	Western North American Ruderal Wet Meadow & Marsh
Baltic Rush Herbaceous Alliance	Wet Meadow	Vancouverian & Rocky Mountain Montane Wet Meadow Group	Baltic Rush Herbaceous Alliance	Juncus balticus Herbaceous Vegetation	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
Narrow-Leaf Willow Shrubland Alliance	Riparain	Rocky Mountain & Great Basin Lowland & Foothill Riparian & Seep Shrubland Group	Narrow-Leaf Willow (=Coyote Willow) Shrubland Alliance	Salix exigua / Mesic Forbs Shrubland	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
Amaranth Mudflat Sparse Herbaceous Alliance	Open Water	Temperate Pacific Freshwater Wet Mudflat Group	Amaranth (California, Green) Mudflat Sparse Herbaceous Alliance	Not mapped to association level	Western North American Lowland Freshwater Wet Meadow, Marsh & Shrubland
Agricultural	Hay	Agricultural	Not mapped to alliance level	Agricultural	Agricultural
Developed	Developed	Developed	Not mapped to alliance level	Developed	Developed
Open Water	Open Water	Open Water	Not mapped to alliance level	Open Water	Open Water
Cultural Woody Vegetation	Shelterbelt	Cultural Woody Vegetation	Not mapped to alliance level	Not mapped to association level	Cultural Woody Vegetation
Non-Vegetated	Shrub Steppe	Non-Vegetated	Not mapped to alliance level	Non-Vegetated	Non-Vegetated
Senescent Vegetation Dominant (Litter)	Hemi-Marsh	Non-Vegetated	Non-Vegetated	Non-Vegetated	Non-Vegetated
Cultural Woody Vegetation	Shelterbelt	Cultural Woody Vegetation	Not mapped to alliance level	Not mapped to association level	Cultural Woody Vegetation

		Reference Data																
Map Data		Baltic Rush Herbaceous Alliance	Broadleaf Cattail Herbaceous Alliance	Common Spike-Rush Herbaceous Alliance	Crested Wheatgrass Ruderal Grassland Alliance	Great Basin & Intermountain Ruderal Dry Shrubland & Grass	Green Rabbitbrush Shrubland and Steppe Alliance	Hard-Stem Bull-Rush Herbaceous Alliance	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal	Intermountain Semi-Desert Grassland & Steppe Group	Narrow-Leaf Willow (=Coyote Willow) Shrubland Alliance	Native Sedge Montane Wet Meadow Alliance	Western North American Ruderal Wet Meadow & Marsh Group	Grand Total			
	Baltic Rush Herbaceous Alliance	30		1				4			2	1		3	41		73.2%	
	Broadleaf Cattail Herbaceous Alliance		1												1		100.0%	
	Common Spike-Rush Herbaceous Alliance			7								0			7		100.0%	
	Crested Wheatgrass Ruderal Grassland Alliance	1			24	1			1		0				27		88.9%	
	Great Basin & Intermountain Ruderal Dry Shrubland & Grass				1	5						1		1	8		62.5%	
	Green Rabbitbrush Shrubland and Steppe Alliance			2		1	10				4		1	1	19		52.6%	
	Hard-Stem Bull-Rush Herbaceous Alliance	1	3					13						1	1	19		68.4%
	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Native								23	4					1	28		82.1%
	Intermountain Dry Tall Sagebrush Shrubland & Steppe Group, Ruderal					2	1	1	1	7						12		58.3%
	Intermountain Semi-Desert Grassland & Steppe Group									1		1				2		50.0%
	Narrow-Leaf Willow (=Coyote Willow) Shrubland Alliance	2	1	1									9			13		69.2%
	Native Sedge Montane Wet Meadow Alliance													1		1		100.0%
Western North American Ruderal Wet Meadow & Marsh Group	1		1			2		1			1			26	32		81.3%	
		35	5	12	27	10	11	18	26	11	8	11	3	33	210			
		85.7%	20.0%	58.3%	88.9%	50.0%	90.9%	72.2%	88.5%	63.6%	12.5%	81.8%	33.3%	78.8%	157			
		Producers Accuracy														74.8%		